

**TECHNICAL SPECIFICATIONS  
FOR  
MODOT WRIGHT CITY REST AREA  
SEWER SYSTEM IMPROVEMENTS**

**ENGINEER:**

SHAFER, KLINE AND WARREN, INC.  
3200 Penn Terrace, Suite 100  
Columbia, MO 65202  
573-234-2610

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DOCUMENT 00005  
CERTIFICATIONS PAGE

	<p>I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Missouri.</p> <p>Signature: <u>Steven R. Schultz</u> Date: <u>3-2-12</u></p> <p>Name: <u>Steven R. Schultz</u></p> <p>Missouri License No.: <u>2001004664</u></p> <p>My license renewal date is <u>December 31, 2012</u>.</p> <p>Pages, Sheets, or Divisions covered by this seal: _____</p> <p>All sheets except C501, and all specification section except for section 16050 and 16905</p>
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DOCUMENT 00005  
CERTIFICATIONS PAGE



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Missouri.

Signature: Dale K. Dickson Date: 3/1/12

Name: Dale K. Dickson

Missouri License No.: E23058

My license renewal date is December 31, 2012.

Pages, Sheets, or Divisions covered by this seal: \_\_\_\_\_

Sheet C501 and spec section 16050 and 16905

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LIST OF DRAWINGS

Drawings are not bound in this book.

Sheet	Drawings	Date
C001	Cover Sheet	03/01/12
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## SECTION 01012

### SUMMARY OF WORK

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Contract Description.
- B. Contractor use of site and work area.
- C. Existing Utilities and Improvements.
- D. Protection of existing property and existing improvements.

##### 1.2 CONTRACT DESCRIPTION

- A. Contract Type: Unit Price.
- B. Work under this contract will include the construction of a 2" sanitary sewer force main, duplex grinder pump lift station, gravity sewer line, site work and electrical service. Work shall include all materials and labor associated with the contract as specified and indicated on the Drawings.

##### 1.3 CONTRACTOR USE OF SITE AND WORK AREA

- A. Limit use of site and work area to maintain traffic on streets and allow property owners access to their property.
- B. Owner has obtained or is in the process of obtaining permanent and temporary easements as is necessary to construct the project. Contractor shall confine construction activities to the apparent public rights-of-way and easements provided. Should Contractor desire temporary easements for construction, access in addition to that obtained by Owner, he shall obtain them at no additional cost to Owner.
- C. Contractor is responsible to make repairs to any property damaged during construction. All materials and workmanship used shall be of equal or better quality to the materials and workmanship used in the original construction of the surface and shall be subject to the approval of the Engineer.

##### 1.4 EXISTING UTILITIES

- A. The size, type and location of all known obstacles in the right-of-way of the proposed construction are shown on the Drawings. Owner does not guarantee the number, type, size or location of the obstacles and they are given only as a guide to the Contractor in their location ahead of excavation. No additional compensation will be allowed for delays or costs caused by existing obstacles being incorrectly located or inadvertently omitted from the Drawings.

##### 1.5 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of site and premises to allow:
  - 1. Owner occupancy, operations, and maintenance.
  - 2. Work by Owner.

- B. Construction Operations:

1. Limited to areas within general limits shown on the Drawings, inside Owners properties and , easements, except where specifically noted on the Drawings.
  2. Contractor may use the areas noted on the Drawings for storage and staging.
- C. Time Restrictions: No work shall be done on Saturday, Sunday, legal holidays, or at night, without the approval of Owner in each case, except such work as may be necessary for the proper care, maintenance and protection of work already done or of equipment and public property covered by the Contract., or to meet demanding time limitations on specific work activities called for under this contract. Approval of Owner shall be sought at least forty-eight (48) hours in advance of such work whenever practicable.
1. Before Contractor requests work to take place on Saturday, Sundays, or legal holidays on repeated basis to expedite the Work or make up for lost progress, Contractor shall first schedule and work five 10-hour weekdays for at least three weeks prior.
- D. Unfavorable Construction Conditions: During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine his operations to Work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.
- E. Utility Outages and Shutdown: Brief shutdown of utilities, other than described herein, will be acceptable to Owner provided that the duration does not exceed one-half hour, and at least 48 hours prior notice has been given by Contractor.

## 1.6 WORK SEQUENCE

- A. The construction sequence specified herein has been developed to serve as a basis to Contractor for development of a complete and comprehensive construction schedule in accordance with Section 01300 - Submittals. The Contractor shall expand the construction schedule from the sequence of construction presented herein. Contractor shall address in his construction schedule, the sequence of construction to be followed for each of the elements of Work identified herein and any other construction activities required for completion of the Work required by the Contract Documents. Alternatives to the sequence of construction below will be considered only if they offer advantages of fewer disruptions to treatment facility operation or the collection system, fewer or shorter duration shutdowns for facility tie-ins, or reduced risk of discharge permit violations. The suggested sequence of construction shall not relieve Contractor from any Work required by the Contract Documents nor from meeting the Contract Times specified in the Agreement.
- B. Sequence of Construction
1. Obtain permit from City of Wright City.
  2. Install silt fence.
  3. Excavate for lift station.
  4. Construct lift station.
  5. Install electric service, sewer mains, and force main connection to City of Wright City.
  6. Install pumps, control panel, and set electric meter.
  7. Perform testing.
  8. Place lift station and force main into service.
  9. Remold bottom of existing MH EX-1, plug line to lagoon, and redirect flow to lift station.
  10. Install perimeter fencing and finish grade/landscape.

## 1.7 LINES AND GRADES

- A. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.

- B. All construction staking is the responsibility of the Contractor.

1.8 CONNECTIONS TO EXISTING FACILITIES

- A. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owing utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.
- B. Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Overtime work shall be scheduled with and approved by Owner in advance, as required within.
- C. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

**PART 2 PRODUCTS**

Not Used.

**PART 3 EXECUTION**

Not Used

**END OF SECTION**

**CONTRACT REQUIREMENTS**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Schedule of values.
- B. Application for payment.
- C. Change procedures.
- D. Alternatives.

1.2 RELATED SECTIONS

- A. Section 01600 - Material and Equipment: Product substitutions.

1.3 SCHEDULE OF VALUES

- A. Submit a printed schedule on Contractor's standard form. Electronic media printout will be considered.
- B. Submit Schedule of Values in duplicate within 20 days after date of Owner-Contractor Agreement.
- C. Revise schedule to list approved Change Orders, with each Application for Payment.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit four copies of each application on Contractor's electronic media driven form.
- B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
- C. Payment Period: 30 days.
- D. Submit waiver of liens from vendors.
- E. Include an updated construction progress schedule.
- F. Certified payroll records.

1.5 CHANGE PROCEDURES

- A. The Architect/Engineer/Designer may issue a Notice of Change that includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required.
- B. The Contractor may propose changes by submitting a request for change to the Architect/Engineer/Designer describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, the effect on the Contract Sum/Price and Contract Time, and a statement describing the effect on Work by the MoDOT District or other Contractors.
- C. Stipulated Sum/Price Change Order: Based on Notice of Change and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by Architect/Engineer/Designer.
- D. Construction Change Directive: Architect/Engineer/Designer may issue a directive instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute the change.

- E. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract. Architect/Engineer/Designer will determine the change allowable in Contract Sum/Price and Contract Time as provided in the Contract Documents.
- F. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.
- G. Execution of Change Orders: Architect/Engineer/Designer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.6 DEFECT ASSESSMENT

- A. Replace the Work, or portions of the Work, not conforming to specify requirements.
- B. If, in the opinion of the Architect/Engineer/Designer, it is not practical to remove and replace the Work, the Architect/Engineer/Designer will direct an appropriate remedy or adjust payment.

1.7 ALTERNATIVES

- A. Accepted Alternatives will be identified in Owner-Contractor Agreement.

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

**COORDINATION AND MEETING REQUIREMENT**

**PART 1 GENERAL**

1.1 SECTION INCLUDES

- A. Coordination and project conditions.
- B. Field engineering.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Preinstallation meetings.
- G. Equipment electrical characteristics and components.
- H. Examination.
- I. Preparation.
- J. Cutting and Patching.
- K. Alteration project procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to and placing in service, such equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work, which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and 4 conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas, except as otherwise indicated, conceal pipes, ducts and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

- A. Employ a Land Surveyor registered in the State of Missouri and acceptable to Architect/Engineer/Designer.
- B. Owner will locate and protect survey control and reference points.
- C. Control datum for survey is that established by Owner provided survey.
- D. Verify setbacks and easements; confirm drawing dimensions and elevations.
- E. Provide field engineering services. Establish elevations, lines and levels, utilizing recognized engineering survey practices.

#### 1.4 PRECONSTRUCTION MEETING

- A. Architect/Engineer/Designer will schedule a meeting after Notice of Award.
- B. Attendance Required: District engineer or representative, Architect/Engineer/Designer and Contractor.
- C. Record minutes and distribute copies within 5 days after meeting to participants, with two copies to District Engineer, Architect/Engineer/Designer, participants and those affected by decisions made.

#### 1.5 SITE MOBILIZATION MEETING

- A. Architect/Engineer/Designer will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Architect/Engineer/Designer will record minutes and distributes copies within 5 days after meeting to participants, with two copies to Architect/Engineer/Designer, participants and those affected by decisions made.

#### 1.6 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at when arranged by Architect/Engineer/Designer.
- B. Architect/Engineer/Designer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, District engineer representative, Architect/Engineer/Designer, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review of Work progress.
  - 2. Field observations, problems, and decisions.
  - 3. Identification of problems, which impede planned progress.
  - 4. Maintenance of progress schedule.
  - 5. Corrective measures to regain projected schedules.
  - 6. Coordination of projected progress.
  - 7. Effect of proposed changes on progress schedule and coordination.
- E. Record minutes and distributes copies within 5 days after meeting to participants and those affected by decisions made.

#### 1.7 PREINSTALLATION MEETING

- A. When required in individual specification sections, convene a pre-installation meeting at the site prior to commencing work of the section.
- B. Notify Architect/Engineer/Designer seven days in advance of meeting date.
- C. Prepare agenda and preside at meeting:
  - 1. Review conditions of installation, preparation and installation procedures.
  - 2. Review coordination with related work.
- D. Record minutes and distributes copies within 5 days after meeting to participants and those affected by decisions made.

**PART 2        PRODUCTS**

Not used

**PART 3        EXECUTION**

Not used

**END OF SECTION**

## SECTION 01300

### SUBMITTALS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed Products list.
- D. Product Data.
- E. Shop Drawings.
- F. Samples.
- G. Design data.
- H. Test reports.
- I. Certificates.
- J. Manufacturer's instructions.
- K. Manufacturer's field reports.
- L. Erection drawings.
- M. Photographic Record

##### 1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 01400 - Quality Control: Manufacturers' field services and reports.
- C. Section 01700 - Contract Closeout: Contract warranties, bonds, manufacturers' certificates and closeout submittals.

##### 1.3 REFERENCES

- A. AGC Associated General Contractors of America publication "The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry".

##### 1.4 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Architect/Engineer accepted form.
- B. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number and specification section number, as appropriate.
- C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- D. Schedule submittals to expedite the Project, and deliver to Architect/Engineer at business address. Coordinate submission of related items.
- E. For each submittal for review, allow 15 days excluding delivery time to and from the contractor.
- F. Identify variations from Contract Documents and Product or system limitations, which may be detrimental to successful performance of the completed Work.
- G. Submittals not requested will not be recognized or processed.

## 1.5 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedule in duplicate within 15 days after date established in Notice to Proceed.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version.
- D. Submit a horizontal bar chart with separate line for each major portion of Work or operation, identifying first workday of each week.

## 1.6 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation and reference standards.

## 1.7 PRODUCT DATA

- A. Product Data For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.
- B. Product Data For Information:
  - 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- C. Product Data For Project Close-out:
  - 1. Submitted for the Owner's benefit during and after project completion.
- D. Submit the number of copies, which the Contractor requires, plus two copies that will be retained by the Architect/Engineer.
- E. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- F. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 - CONTRACT CLOSEOUT.

## 1.8 SHOP DRAWINGS

- A. Shop Drawings For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.
- B. Shop Drawings For Information:
  - 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.

- C. Shop Drawings For Project Close-out:
  - 1. Submitted for the Owner's benefit during and after project completion.
- D. Indicate special utility and electrical characteristics, utility connection requirements and location of utility outlets for service for functional equipment and appliances.
- E. Submit in the form of one reproducible transparency and one opaque reproduction.

#### 1.9 SAMPLES

- A. Samples For Review:
  - 1. Submitted to Architect/Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
  - 2. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.
- B. Samples For Information:
  - 1. Submitted for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- C. Samples For Selection:
  - 1. Submitted to Architect/Engineer for aesthetic, color, or finish selection.
  - 2. Submit samples of finishes for Architect/Engineer selection.
  - 3. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSEOUT.

#### 1.10 DESIGN DATA

- A. Submit for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### 1.11 TEST REPORTS

- A. Submit for the Architect/Engineer's knowledge as contract administrator or for the Owner.
- B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

#### 1.12 CERTIFICATES

- A. When specified in individual specification sections, submit certification by the manufacturer, installation/application subcontractor, or the Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to Architect/Engineer.

#### 1.13 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing, to Architect/Engineer for delivery to owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention and special environmental criteria required for application or installation.

- C. Refer to Section 01400 - Quality Control, Manufacturers' Field Services article.

1.14 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for the Architect/Engineer's benefit as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.

1.15 ERECTION DRAWINGS

- A. Submit drawings for the Architect/Engineer's benefit as contract administrator or for the Owner.
- B. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by the Architect/Engineer or Owner.

1.16 PHOTOGRAPHIC RECORD

- A. Prior to commencement of construction, the Contractor shall make a photographic record of all sites. The photographs shall be of sufficient detail to reveal the character of existing surfaces, including the condition of such features as curbs, sidewalks, driveways and inlets which may be affected by construction operations. All photographs shall be marked for identification, showing location by site number and station number. All photographs shall be 4x6 color prints. One set of bound photographs shall be submitted to the Owner for approval prior to commencement of construction operations. Direct compensation will not be paid for this requirement which shall be subsidiary to other items of the contract.

**PART 2 PRODUCTS**

NOT USED

**PART 3 EXECUTION**

NOT USED

**END OF SECTION**

## SECTION 01400

### QUALITY CONTROL

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality assurance - control of installation.
- B. Tolerances
- C. References and standards.
- D. Mock-up.
- E. Inspecting and testing laboratory services.
- F. Manufacturers' field services.

##### 1.2 RELATED SECTIONS

- A. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.
- B. Section 01600 - Material and Equipment: Requirements for material and product quality.
- C. Section 01650 - Starting of Systems.

##### 1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

##### 1.4 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

##### 1.5 REFERENCES AND STANDARDS

- A. For products or workmanship specified by association, trade or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date for receiving bids or date specified in the individual specification sections, except where a specific date is established by code.
- C. Neither the contractual relationships, duties or responsibilities of the parties in Contract nor those of the Architect/Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

## 1.6 TESTING SERVICES

- A. Contractor to provide all testing services as called out in these specifications.
- B. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Architect/Engineer or the Owner.
- C. Testing does not relieve Contractor to perform Work to contract requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same MoDOT personnel on instructions by the Architect/Engineer.

## 1.7 INSPECTION SERVICES

- A. Owner will employ MoDOT Personnel to perform inspection.
- B. Inspecting may occur on or off the project site. Perform off-site inspecting as required by the Architect/Engineer or the Owner.
- C. Inspecting does not relieve Contractor to perform Work to contract requirements.

## 1.8 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and the balancing of equipment as applicable and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- C. Refer to Section 01300 - SUBMITTALS, MANUFACTURERS' FIELD REPORTS article.

## **PART 2 PRODUCTS**

NOT USED

## **PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

### 3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer or conditioner prior to applying any new material or substance in contact or bond.

**END OF SECTION**

## SECTION 01500

### CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Temporary Utilities: Electricity, telephone service, facsimile service and sanitary facilities.
- B. Temporary Controls: enclosures and fencing, protection of the Work and water control.
- C. Construction Facilities: progress cleaning and temporary buildings.

##### 1.2 TEMPORARY ELECTRICITY

- A. Cost: By Contractor; pay for temporary power service furnished by MoDOT.

##### 1.3 TELEPHONE SERVICE

- A. NOT APPLICABLE.

##### 1.4 FACSIMILE SERVICE

- A. NOT APPLICABLE.

##### 1.5 TEMPORARY WATER SERVICE

- A. Connect to existing water source as directed for construction operations at time of project mobilization.
- B. Contractor will reimburse Owner for water used in construction as agreed upon at time of project mobilization.

##### 1.6 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

##### 1.7 FENCING

- A. Construction: Use plastic mesh safety fencing or better.
- B. Provide 48" high fence around construction site; equip with vehicular and pedestrian gates with locks.

##### 1.8 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

##### 1.9 EXTERIOR ENCLOSURES

- A. NOT APPLICABLE

#### 1.10 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

#### 1.11 SECURITY

- A. Provide security and facilities to protect Work and existing facilities and Owner's operations from unauthorized entry, vandalism or theft.
- B. Coordinate with Owner's security program.

#### 1.12 ACCESS ROADS

- A. Provide and maintain access to fire hydrants, free of obstructions.
- B. Provide means of removing mud from vehicle wheels before entering streets.
- C. Designated existing on-site roads may be used for construction traffic.

#### 1.13 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris and rubbish from site periodically and dispose off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

#### 1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities and materials prior to Final Application for Payment inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

### **PART 2 PRODUCTS – NOT USED**

### **PART 3 EXECUTION – NOT APPLICABLE**

**END OF SECTION**

## SECTION 01600

### MATERIAL AND EQUIPMENT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Products.
- B. Transportation and handling.
- C. Storage and protection.
- D. Product options.
- E. Substitutions.

##### 1.2 RELATED SECTIONS

- A. Instructions to Bidders: Product options and substitution procedures.
- B. Section 01400 - Quality Control: Product quality monitoring.

##### 1.3 PRODUCTS

- A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- B. Provide interchangeable components of the same manufacture for components being replaced.

##### 1.4 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct and products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement or damage.

##### 1.5 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive Products in weather tight, climate controlled, enclosures in an environment favorable to Product.
- D. For exterior storage of fabricated Products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement or damage.
- I. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

##### 1.6 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any Product meeting those

- standards or description is acceptable.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named in accordance with the following article.

1.7 SUBSTITUTIONS

- A. Architect/Engineer will consider requests for Substitutions only within 15 days after date established in Notice to Proceed.
- B. Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
  - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
  - 2. Will provide the same warranty for the Substitution as for the specified Product.
  - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
  - 5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
  - 1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
  - 2. Submit shop drawings, product data and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
  - 3. The Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

**PART 2 PRODUCTS**

Not Used.

**PART 3 EXECUTION**

Not Used.

**END OF SECTION**

## SECTION 01650

### STARTING OF SYSTEMS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Starting systems.
- B. Demonstration and instructions.
- C. Testing, adjusting and balancing.

##### 1.2 RELATED SECTIONS

- A. Section 01400 - Quality Control: Manufacturers field reports.
- B. Section 01700 - Contract Closeout: System operation and maintenance data and extra materials.

##### 1.3 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect/Engineer seven days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative or Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01300 that equipment or system has been properly installed and is functioning correctly.

##### 1.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Final Completion.
- B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.
- D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance and shutdown of each item of equipment at agreed time, at equipment location.
- E. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instruction.
- F. The amount of time required for instruction on each item of equipment and system that's specified in individual sections.

#### PART 2 PRODUCTS

Not Used.

#### PART 3 EXECUTION

Not Used.

**END OF SECTION**

## SECTION 01700

### CONTRACT CLOSEOUT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Operation and maintenance data.
- F. Spare parts and maintenance Products.
- G. Warranties.

##### 1.2 RELATED SECTIONS

- A. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.
- B. Section 01650 - Starting of Systems: System start-up, testing, adjusting and balancing.

##### 1.3 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Owner that is required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments and sum remaining due.

##### 1.4 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- C. Clean or replace filters of operating equipment used during construction and/or adjustment.
- D. Clean debris from roofs, gutters, downspouts and drainage systems.
- E. Clean site; sweep paved areas, rake clean landscaped surfaces.
- F. Remove waste and surplus materials, rubbish and construction facilities from the site.

##### 1.5 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

##### 1.6 PROJECT RECORD DOCUMENTS

- A. Store record documents separate from documents used for construction.
- B. Record information concurrent with construction progress.
- C. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.

- D. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured depths of foundations in relation to finish main floor datum.
  - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 4. Field changes of dimension and detail.
  - 5. Details not on original Contract drawings.
- E. Submit documents to Architect/Engineer with claim for final Application for Payment.

#### 1.7 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable plastic covers.
- B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Submit 1 draft copy of completed volumes 15 days prior to final inspection. This copy will be reviewed and returned with Architect/Engineer comments. Revise content of all document sets as required prior to final submission.
- E. Submit two sets of revised final volumes, within 10 days after final inspection.

#### 1.8 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra Products in quantities specified individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

#### 1.9 WARRANTIES

- A. Execute and assemble transferable warranty documents from Subcontractors, suppliers and manufacturers.
- B. Submit prior to final Application for Payment.
- C. For items of Work delayed beyond date of Final Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of the warranty period.

### **PART 2 PRODUCTS**

Not Used.

### **PART 3 EXECUTION**

Not Used.

**END OF SECTION**

**02100**

**SITE PREPARATION**

**PART 1 SCOPE**

- A. The contractor shall visit the site and carefully examine the conditions of the premises to determine the amount of work and materials required for the work necessary to prepare the site in every respect for the construction of the truck wash.
- B. The contractor shall be responsible for determining the quantities of materials to be excavated and handled and for the amount of backfilling, filling and grading to be done in order to perform all work required on the plans.
- C. Unused /waste earth material can be stockpiled on site where directed by Owner.

**PART 2 PRODUCTS**  
NOT USED

**PART 3 EXECUTION**  
NOT USED

**END OF SECTION**

**EXCAVATING, BACKFILLING AND COMPACTING**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Excavate, backfill, compact, and grade the site to the elevations shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.
- B. Related work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.

1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use equipment adequate in size, capacity and numbers to accomplish the work of this Section in a timely manner.
- C. In addition to complying with requirements of governmental agencies having jurisdiction, comply with the directions of the MoDOT Inspector.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Comply with pertinent provisions of Section 01620.

**PART 2 PRODUCTS**

2.1 SOIL MATERIALS

- A. Fill and backfill materials:
  - 1. Provide soil materials free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2-3/8" in their greatest dimension.
  - 2. Fill material is subject to the approval of the MoDOT Inspector, and are those materials removed from excavations or imported from off-site borrow areas; predominantly granular, non-expansive soils free from roots and other deleterious matter.
  - 3. Do not permit rocks having a dimension greater than 1" in the upper 12" of fill or embankment.
  - 4. Cohesionless material used for structural backfill. Provide sand free from organic material and other foreign matter, and as approved by the MoDOT Inspector.
  - 5. Where granular base is called for under building slabs, provide aggregate complying with requirements of Section 03300 of these Specifications.

2.2 WEED KILLER

- A. Provide a dry, free-flowing, dust-free chemical compound, soluble in water, capable of inhibiting growth of vegetation, and approved for use on this Work by governmental agencies having jurisdiction.

## 2.3 TOPSOIL

- A. Where and if shown on the Drawings or otherwise required, provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoil, roots, heavy or stiff clay, stones larger than 2" in greatest dimension, noxious weeds, sticks, brush, litter and other deleterious matter.
- B. Obtain topsoil/backfill from sources within the project limits as approved by Owner, or provide imported topsoil obtained from sources outside the project limits or from both sources.

## 2.4 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

## **PART 3 EXECUTION**

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

### 3.2 FINISH ELEVATIONS AND LINES

- A. Comply with grades shown on Plan Sheets.

### 3.3 PROCEDURES

- A. Utilities:
  - 1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
  - 2. If active utility lines are encountered and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
  - 3. If service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
  - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Architect and secure his instructions.
  - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Architect.
- B. Protection of persons and property:
  - 1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
  - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
  - 3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.

- C. Dewatering:
  - 1. Remove all water, including rainwater encountered during trench and sub-structure work to an approved location by pumps, drains and other approved methods.
  - 2. Keep excavations and site construction area free from water.
- D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors and to other work being performed on or near the site.
- E. Maintain access to adjacent areas at all times.

### 3.4 EXCAVATING

- A. Perform excavating of every type of material encountered within the limits of the Work to the lines, grades and elevations indicated and specified herein.
- B. Satisfactory excavated materials:
  - 1. Transport to and place in, fill or embankment areas within the limits of the Work.
- C. Unsatisfactory excavated materials:
  - 1. Excavate to a distance below grade as directed by the MoDOT Inspector and replace with satisfactory materials.
  - 2. Include excavation of unsatisfactory materials and replacement by satisfactory materials, as parts of the work of this Section.
- D. Surplus materials:
  - 1. Dispose of unsatisfactory excavated material, and surplus satisfactory excavated material, away from the site at disposal areas arranged and paid for by the Contractor.
- E. Excavation of rock:
  - 1. Where rocks, boulders, granite, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, take required steps to proceed with the general grading operations of the Work, and remove or excavate such material by means which will neither cause additional cost to the Owner nor endanger buildings or structures whether on or off the site.
  - 2. Do not use explosives without written permission from the Architect.
- F. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.
- G. Borrow:
  - 1. Obtain material required for fill or embankment in excess of that produced within the grading limits of the Work from borrow areas selected and paid for by the Contractor and approved by the MoDOT Inspector.
- H. Ditches and gutters:
  - 1. Cut accurately to the cross sections, grades and elevations shown.
  - 2. Maintain excavations free from detrimental quantities of leaves, sticks, trash, and other debris until completion of the Work.
  - 3. Dispose of excavated materials as shown on the Drawings or directed by the MoDOT Inspector; except do not, in any case, deposit materials less than 3'-0" from the edge of a ditch.
- I. Unauthorized excavation:
  - 1. Unauthorized excavation consists of removal of materials beyond indicated subgrade

elevations or dimensions without specific instruction from the Architect or the MoDOT Inspector.

2. Under footings, foundations, or retaining walls:
  - a. Fill unauthorized excavations by extending the indicated bottom elevation of the footing or base to the excavation bottom, without altering the required top elevation.
  - b. When acceptable to the soil engineer, lean concrete fill may be used to bring the bottom elevation to proper position.
3. Elsewhere backfill and compact unauthorized excavations as specified for authorized excavations, unless otherwise directed by the soil engineer.

J. Stability of excavations:

1. Slope sides of excavations to 1:1 or flatter, unless otherwise directed by the MoDOT Inspector.
2. Shore and brace where sloping is not possible because of space restrictions or stability of the materials being excavated.
3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.

K. Excavating for structures:

1. Conform to elevations and dimensions shown within a tolerance of 0.10 ft, and extending a sufficient distance from footings and foundations to permit placing and removing concrete formwork, installation of services, other construction required and for inspection.
2. In excavating for footings and foundations, take care not to disturb bottom of excavation:
  - a. Excavate by hand tools to final grade just before concrete is placed.
  - b. Trim bottoms to required lines and grades to leave solid base to receive concrete.
3. Excavate for footings and foundations only after general site excavating, filling and grading are complete.

L. Excavating for pavements:

1. Cut surface under pavements to comply with cross sections, elevations and grades.

M. Cold weather protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

### 3.5 FILLING AND BACKFILLING

A. General:

1. For each classification listed below, place acceptable soil material in layers to required subgrade elevations.
2. In excavations:
  - a. Use satisfactory excavated or borrowed materials.
3. Under building slabs:
  - a. Use subbase materials.
4. Under building slabs:
  - a. Use granular fill, if so called for on the Drawings, complying with aggregate acceptable under Section 03300 of these Specifications.

B. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following.

1. Acceptance of construction below finish grade including, where applicable, dampproofing

- and waterproofing.
  - 2. Inspecting, testing, approving and recording locations of underground utilities.
  - 3. Removing concrete formwork.
  - 4. Removing shoring and bracing and backfilling of voids with satisfactory materials.
  - 5. Removing trash and debris.
  - 6. Placement of horizontal bracing on horizontally supported walls.
- C. Ground surface preparation:
- 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious matter from ground surface prior to placement of fills.
  - 2. Plow, strip, or break up sloped surfaces steeper than one vertical to four horizontal so that fill material will bond with existing surface.
  - 3. When existing ground surface has a density less than that specified under "compacting" for the particular area, break up the ground surface, pulverize moisture-condition to the optimum moisture content and compact to required depth and percentage of maximum density.
- D. Placing and compacting:
- 1. Place backfill and fill materials in layers not more than 8" in loose depth.
  - 2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
  - 3. Compact each layer to required percentage of maximum density for area.
  - 4. Do not place backfill or fill material on surfaces that are muddy, frozen or containing frost or ice.
  - 5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
  - 6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
  - 7. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.

### 3.6 GRADING

- A. General:
- 1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
  - 2. Smooth the finished surfaces within specified tolerance.
  - 3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.
  - 3. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition or if such a transition defeats positive control of drainage.
- B. Grading outside building lines:
- 1. Grade areas adjacent to buildings to achieve drainage away from the structures and to prevent ponding.
  - 2. Finish the surfaces to be free from irregular surface changes, and:
    - a. Shape the surface of areas scheduled to be under walks to line, grade and cross-section, with finished surface not more than 0.10 ft above or below the required subgrade elevation.
    - b. Shape the surface of areas scheduled to be under pavement to line, grade and cross-section, with finished surface not more than 0.05 ft above or below the required subgrade elevation.

### 3.7 COMPACTING

- A. Control soil compaction during construction to provide the minimum percentage of density specified for each area as determined according to ASTM D1557.
- B. Provide not less than the following maximum density of soil material compacted at optimum moisture content for the actual density of each layer of soil material in place and as approved by the MoDOT Inspector.
  - 1. Structures:
    - a. Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density.
  - 2. Lawn and unpaved areas:
    - a. Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density.
    - b. Compact the upper 12" of filled areas, or natural soils exposed by excavating, at 85% of maximum density.
  - 3. Walks:
    - a. Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density.
  - 4. Pavements:
    - a. Compact the top 8" of subgrade and each layer of fill material or backfill material at 90% of maximum density.
- C. Moisture control:
  - 1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations.
  - 2. Remove and replace or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
  - 3. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by disking, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the MoDOT Inspector.

### 3.8 MAINTENANCE

- A. Protection of newly graded areas:
  - 1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds;
  - 2. Repair and establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape and compact to the required density prior to further construction.

**END OF SECTION**

## SECTION 02320

### EARTHWORK AND TRENCHING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. The Contractor shall perform all excavation, embankment, trenching, backfilling, cushioning, surface dressing, dewatering, shoring, surface restoration and disposal of waste as required for site grading, structures, piping, and appurtenances as shown on the Drawings.

##### 1.2 SECTION INCLUDES

- A. Disposal of materials.
- B. Tree removal.
- C. Site clearing and preparation.
- D. Excavation.
- E. Construction of fills and embankments.
- F. Trenching.
- G. Pipe embedment requirements.
- H. Pipe embedment schedule.
- I. Crushed rock.
- J. Backfilling.

##### 1.3 RELATED SECTIONS

- A. Section 02922 - Seeding.
- B. Section 03300 - Miscellaneous Concrete.

##### 1.4 REFERENCES: The following publications form a part of these specifications to the extent indicated by references thereto. The revision in effect at the time of the Bid Opening shall be applicable. If these publications conflict with the requirements of this section, the section requirements shall govern.

- A. American Society for Testing Materials (ASTM):
  1. D-698 - Moisture-Density Relations Of Soils, Using 5.5 Pound (2.5 kg) Rammer And 12-Inch (304.8 mm) Drop.
  2. D-1577 - Test Method for Laboratory Compaction of Soil Using Modified Effort.
  3. D-1140 - Test Method for Amount of Material in Soils Finer Than the No. 200 (75 $\Phi$ m) Sieve.
  4. D-2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  5. D-3017 - Standard Test Methods for Water content of Soil and rock by Nuclear Methods.

1.5 SUBMITTALS: The Contractor shall submit the following items required by this division in accordance with Section 01300 - Submittals.

A. Product data for review: Soil test results as specified herein for soil testing.

1.6 DEFINITIONS

A. Earth excavation: Earth excavation is defined as the removal of all material whose removal is not defined as rock excavation.

B. Pipe embedment: Pipe embedment is defined as soil or stone aggregate material placed under, around, and in some cases over the pipe. The material type and extent of embedment is specified herein and shown on the Drawings.

C. Trench backfill: Trench backfill is defined as soil or stone aggregate material placed in a pipe or utility trench, above the pipe embedment and up to the existing ground surface, finished grade, or the bottom of pavement.

D. Structure backfill: Structure backfill is defined as soil or stone aggregate material placed around or above subsurface structures, such as manholes, vaults, foundations, and wetwells.

1.7 MAINTENANCE OF WORK: The Contractor shall be responsible for the satisfactory compaction and maintenance of all completed excavation, embankment, and backfill. If, prior to the expiration of the General Guaranty period stipulated in the Front End Documents, any grades or subgrades are found to have settled or eroded, they shall be reworked immediately by the Contractor and restored to the specified grades, and the surface restored.

## PART 2 PRODUCTS

2.1 GENERAL

A. Materials shall conform to the respective references listed above and other requirements specified herein.

B. Topsoil, and material required for structural backfill and trench backfill in excess of suitable material excavated from trenching and structural excavation shall be furnished by the Contractor at no additional cost to the Owner.

2.2 PIPE EMBEDMENT MATERIAL

A. Granular Embedment Material: Granular embedment material for installation in pipe trenches and other locations indicated on the Drawings shall be crushed stone conforming to the 2007 MCIB Concrete Standards, Section 2.1.D for coarse aggregate meeting the gradation specified under Column IV, Table 2.1.D-1 for 2-inch aggregate with the modification that the maximum allowable percentage of material finer than No. 200 sieve shall be between 2.0% and 5.0% as determined by ASTM C-117. The gradation is repeated below for information:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4"	100
1/2"	80 - 100
3/8"	40 - 70

No. 4	0 - 15
No. 8	0 - 5
No. 200	0 - 3

2.3 CRUSHED ROCK: Crushed rock for use beneath concrete slabs and structures, and in other locations shown on the Drawings, shall be freely draining, siliceous gravel or crushed stone aggregate, conforming to 1999 Missouri Standard Specifications for Highway Construction, Section 1007, Type 1007.4.3. The gradation is repeated below for information:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
1/2"	55 - 90
No. 4	8 - 40
No. 10	0 - 15
No. 200	0 - 4

2.4 FILL MATERIALS

- A. Random Fill Material: Random fill material for earthfills, embankments and other uses, shall be a soil material which is free from: rocks or stones larger than 6 inches in greatest dimension, brush, stumps, logs, roots, debris, top soil, and organic or harmful materials. The portion of fill material passing the No. 40 sieve shall have a liquid limit not exceeding 40 and a plastic limit not exceeding 25, when tested in accordance with ASTM D-4318. To the extent possible, site excavated material may be used. Random fill material shall be imported if suitable soil material is not available on site.
- B. Select Fill Material: Select fill material shall be a sorted, job-excavated or imported soil material as specified for random backfill material, except no rocks, stones, or lumps larger than one inch in largest dimension shall be present. Select fill material, used for filling beneath or against structures, shall not contain weathered shale.
- C. Granular Fill Material:
  - 1. Granular fill material shall be a densely graded gravel of the following gradation:

<u>Sieve Size</u> <u>(square opening)</u>	<u>Percent Passing</u> <u>(by weight)</u>
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 -25
No. 200	5 -15

2. Granular fill material shall be free from clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The fraction passing the No. 200 sieve shall not exceed : of the fraction passing the No. 40 sieve.

## 2.5 IMPERVIOUS TRENCH CHECK MATERIAL

- A. Material for impervious trench checks shall be naturally occurring clay or a soil and sodium bentonite mixture with the permeability of the material to be no greater than  $10 \times 10^{-6}$  cm/sec.
- B. Material shall be free of any stones, bricks, concrete, etc., except gravel or crushed rock of 3/4 inch size or less.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. The Contractor shall verify that required lines, levels, contours and datum are as shown in the plans.
- B. Grading, excavation and backfilling shall be made to the lines, grades and cross sections indicated in the plans.
- C. The Contractor shall maintain the site and conduct earthwork operations to ensure that the property is well drained at all times. The Contractor shall protect adjacent and downstream properties from damage or pollution caused by erosion. The Contractor is responsible for erosion control measures and methods and shall conduct earthwork operations to ensure the protection of all downstream and adjacent properties. The Contractor shall implement any additional erosion control measures to prevent damage.
- D. Existing Utilities:
  1. The Contractor shall verify the location and depth of all utilities a minimum of 24 hours prior to construction. The Contractor may utilize the toll free number for the "Missouri One Call System" 1-800-344-7483. This number is applicable anywhere within the state of Missouri. Prior to commencement of work the Contractor shall notify all those companies which have facilities in the vicinity of the construction.
  2. Coordinate removal or relocation of existing utilities with their Owner.
  3. Locate, identify and protect utilities that remain from damage. The Contractor shall make every reasonable effort to protect all existing utilities from damage. If any utility is damaged through the carelessness or negligent actions of the Contractor, the utility shall be repaired by its owner at the Contractor's expense.
  4. Abandoned pipes which the Drawings indicate shall be capped or filled do not need to be removed. All other abandoned pipe conduit within the limits of grading shall be removed by the Contractor
- E. Existing fences: Fences within the construction grading area shall be removed and reconstructed to equal or better quality than that of the fence removed. It shall be the sole responsibility of the Contractor to maintain all gates, fences, cattle guards and the like encountered during construction, as required to prevent the straying of pets and livestock.

- 3.2 CLASSIFICATION OF MATERIALS: No classification of excavated materials, regardless of type or condition, will be made for purposes of payment. All excavation shall be unclassified. Excavation and trenching work shall include the handling and removal of all materials, regardless of its nature, excavated or removed from the site in performance of the Work. No separate payment will be made for rock.

### 3.3 SITE CLEARING

- A. Clearing and stripping: All stumps, roots, buried logs, foundations, drainage structures, or other miscellaneous debris occurring within the limits of the excavation and site grading shall be removed as part of the grubbing operations and disposed of by, and at the expense of, the Contractor. Like-wise, six inches of topsoil shall be stripped from the disturbed construction areas and stockpiled for later use in final grading.
- B. Stumps and roots in excavated or fill areas where depth of fill does not exceed 3 feet shall be removed to a depth of 18 inches below subgrade. In fill areas where more than 3 feet of fill is required, roots and stumps shall be cut off at the face of the excavation.

### 3.4 SUBGRADE PREPARATION

- A. Proof-roll subgrade below building slabs, tank slabs, and pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.
  - 4. Subgrades under building slabs shall be compacted in place to ninety-five percent (95%) of maximum density as determined by ASTM D-698, at a moisture content within plus or minus two percent ( $\pm 2\%$ ) of optimum.
- B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

### 3.5 EARTHFILLS AND EMBANKMENTS

- A. Material and Compaction Requirements:
  - 1. Fill areas which are below structures, concrete slabs, or paved areas, and within 5 horizontal feet of a structure or concrete slab shall be filled with select fill material, as specified herein, unless otherwise indicated on the Drawings. The select fill material shall be placed in lifts not exceeding 12 inches in compacted thickness, and shall be compacted to a minimum 95 percent of maximum density as determined by ASTM D-698. Fill shall be placed and compacted at a moisture content within  $\pm 2$  percent of optimum.
  - 2. Fill areas which are outside the envelope described above shall be filled with random fill material, as specified herein, unless otherwise indicated on the Drawings. The random fill material shall be placed in lifts not exceeding 12 inches in compacted thickness, and shall be compacted to a minimum 90 percent of maximum density as determined by ASTM D-698. Fill shall be placed and compacted at a moisture content within  $\pm 3$  percent of optimum.
    - a. For areas which will be surfaced with gravel, the top two feet of random fill shall be compacted to a minimum of 95 percent of maximum density as determined by ASTM D-698. Fill shall be placed and compacted at a moisture content within  $\pm 2$  percent of optimum.
- B. All vegetation and topsoil, and any loose, unstable or unsuitable material shall be removed from the existing surface to receive fill material. After stripping, the area shall be proof-rolled with a loaded tandem axel dump truck, or other equipment acceptable to Engineer. Unstable materials located by proof-rolling, shall be removed and replaced with suitable compacted fill material.
- C. Before placing any fill the existing surface shall be scarified, moisture conditioned as required and the top 6 inches compacted to 90 percent of the maximum density for that material in accordance with ASTM D-698.

- D. When embankments, regardless of height, are placed against hillsides or existing embankments having a slope steeper than 1 vertical to 4 horizontal, the existing slope shall be benched or stepped in approximately 24 inch rises. The material shall be bladed out and the bottom area cut to form benches and the embankment material being placed shall be compacted to the specified density. Formation and compaction of benches shall not be measured and paid for directly but will be considered incidental work.
- E. Where embankments of two feet or less are placed over existing pavement, the existing pavement shall be removed and the cleared surface compacted to the specified density. Where embankments greater than two feet are placed over existing pavement, the pavement shall be broken into pieces with a maximum dimension of 24 inches and the pieces left in place.
- F. Do not place fill material over porous, wet, frozen or spongy surfaces. Embankment construction shall not be performed when fill material is frozen or contains frost or snow.
- G. Placement: Place earth embankments in successive horizontal lifts uniformly distributed over the full width of the fill area. Each lift shall not exceed the specified thickness and shall be compacted to the specified density prior to placing any additional lifts. As compaction of each layer progresses, continuous blading and dozing will be required to level the surface and insure uniform compaction.
- H. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so they do not interfere with proper compaction, as determined by the Engineer.

### 3.6 EXCAVATION

- A. General:
  - 1. Where necessary, satisfactory sheeting and bracing shall be used to hold the sides of the excavation at all points where damage might result from slides.
    - a. All sheeting and bracing shall be removed as the backfill is placed, unless otherwise directed in writing by the Owner or shown on the Drawings. All voids left or caused by the withdrawal of sheeting shall be filled immediately with suitable material and tamped.
  - 2. Excavation below structure or trench subgrade:
    - a. Over excavation of pipe trenches due to Contractor=s oversight, shall be backfilled with granular embedment material compacted in 8-inch lifts to 90 percent of the maximum density for that material in accordance with ASTM D-698, as required at no additional cost to the Owner.
    - b. Over excavation of structure subgrades, shall be replaced with concrete placed monolithic with the structure above.
    - c. When unstable or unsuitable material is encountered in the subgrade, such material shall be removed, replaced with crushed rock (for structures) or granular pipe embedment material (for trenches) and compacted to the density equal to or greater than required for subsequent backfill material. Such excavation and backfill shall be done at no additional cost to Owner.
    - d. When the subgrade bottom is soft and in the opinion of the Engineer cannot support the foundation, a further depth and/or width shall be excavated and refilled to the desired pipe or foundation grade with crushed rock, as required by the Engineer to assure a firm foundation. Such excavation and backfill shall be done at no additional cost to Owner.
  - 3. No blasting of any kind for rock excavation or for other purposes will be permitted unless permission is given in writing from the Owner.
  - 4. Dewatering: Each excavation shall be kept dry during subgrade or pipe embedment preparation, and continually thereafter until the structure or pipe is completely installed, to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

- a. All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level at least 12 inches below the bottom of the excavation.
- b. Trenches shall be drained so that workmen may work efficiently. The discharge of pumps used for draining the trenches shall be led to natural drainage courses or drains.

B. Structure Excavation:

- 1. Excavation for structures shall be performed to the limits indicated on the Drawings.
- 2. All suitable material removed by excavation shall be used as far as practicable for backfill and embankment as required to complete the work. The Contractor shall sort all excavated material and stockpile suitable material as necessary. Stockpile excavated material to be used as fill and backfill in area designated on site and remove excess material or unsuitable material not being reused, from site.

C. Trenching:

- 1. All pipeline excavation shall be open cut. The Contractor shall not open more trench in advance of the pipe laying than is necessary. The length of open trenches shall be limited depending on the nature of the soil and safety considerations. All open trenches shall be adequately protected using fencing, barricades, etc. as required.
- 2. Trenches shall be excavated within the limits of public right-of-way in conformance with the requirements herein. Trenches shall be excavated to the width and depth necessary to install sewer pipe to the lines, grades and elevations shown on the Drawings.
- 3. In those areas designated to be landscaped, seeded or sodded, the top soil shall be excavated, stockpiled and replaced as specified herein.
- 4. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One city block or 300 feet, whichever is the shorter, shall be the maximum allowable length of open trench ahead of pipe laying.
- 5. Limiting trench widths: Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and placement and compaction of embedment. However, the limiting trench widths below an elevation 12 inches above the top of the installed pipe shall be as follows:

<u>Pipe Size (inches)</u>	<u>Minimum Trench Width (inches)</u>	<u>Min. Clearance on Each Side of Pipe (inches)</u>	<u>Maximum Trench Width (inches)</u>
< 4	20	6	26
4 - 6	22	6	30
8	22	6	30
10	24	6	32
12	27	6	36
15	30	6	38
16	32	6	40
18	34	6	42

- 6. Unauthorized trench widths: Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing table, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as

required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.

7. Trench bottom in earth: The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the embedment is to be laid. The surface shall be graded to provide a uniform bearing and continuous support. No part of the bell shall be in contact with the trench bottom.
8. The Contractor shall sort and stockpile excavated material so that suitable material is available for backfill. Excavated material shall be deposited on the side of the trenches and beyond the reach of slides. Excavated material not suitable for backfill shall be promptly removed from the site.
9. Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes, but sloping trench walls shall not extend lower than 1 foot above the top of the pipe.
10. Trench Shields: Where trench shields are used by the Contractor, no part of the shield shall exceed lower than 6 inches above the top of the pipe, nor shall the maximum allowable trench width be exceeded.

### 3.7 PIPE EMBEDMENT

- A. Embedment Classes: Embedment classes shall be as follows, and as detailed on the Drawings. All lifts are given in compacted thickness. All compaction percentages refer to maximum dry density as determined by ASTM D-698. Select fill material shall be compacted within 2% of optimum moisture content. Select fill material shall be replaced with granular fill material if granular fill material is required for trench fill to ground surface.
  1. Class A Embedments:
    - a. Class A-1 embedment shall provide a cradle of concrete with a compressive strength of at least 3,000 psi, as specified in Section 03300 - Miscellaneous Concrete. After the initial set of the concrete, granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%, above the top of pipe.
    - b. Class A-2 embedment shall provide an arch of concrete with a compressive strength of at least 3,000 psi, as specified in Section 03300 - Miscellaneous Concrete. Granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%, up to the centerline of the pipe. A concrete arch shall be placed on the granular embedment. After the concrete has set, one foot of select fill material shall be placed above the top of pipe, compacted in 8-inch lifts to a minimum of 85%.
  2. Class B Embedments:
    - a. Class B-1 embedment shall provide an encasement of granular embedment material, extending below the pipe to above the top of pipe. Granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%.
    - b. Class B-2 embedment shall provide a cradle of granular embedment material which shall be placed in 6-inch lifts and compacted to a minimum of 90%. Select fill material shall then extend above the top of the pipe, placed in 8-inch lifts and compacted to 85%.
  3. Class C Embedment: Materials and compaction requirements shall be as for Class B-2.
  4. Class D Embedment: Shall allow the pipe to rest on a flat or restored trench bottom. Pipe embedment shall be select fill material extending from the bottom of the pipe to above the top of pipe, placed in 12-inch lifts and compacted to 85%.
  5. Class E Embedment: Shall provide a cradle of granular embedment material which shall be placed in 6-inch lifts and compacted to a minimum of 90%. Select fill material shall then extend above the top of the pipe, placed in 12-inch lifts and compacted to 85%.
- B. Concrete Encasement: Where indicated on the Drawings, concrete encasement shall be provided instead of the pipe embedment classes specified herein. Requirements for concrete encasement are

detailed on the Drawings. Concrete and reinforcement shall be as specified in Section 03300 - Miscellaneous Concrete, for 3,000 psi concrete.

- C. Pipe Embedment Class Schedule: Unless otherwise noted on the Drawings, pipe embedment classes shall be provided according to the following schedule:

<u>Pipe Material</u>	<u>Depth over pipe (feet)</u>	<u>Embedment class</u>
SDR-35 PVC	All	B-1
Class 200 PVC in soil	All	D
Class 200 PVC in rock	All	E
SDR-PR PVC, SCH 40/80 PVC	All	B-1
C-900 PVC	All	B-1
HDPE (polyethylene)	All	B-2
DIP in soil	up to 12-inch	minimum 3 ft
	over 12-inch	minimum 3 ft
DIP in rock	all sizes	minimum 3 ft
Copper	All	E
Other types not listed here	All	B-2

- D. Placement of Embedment:

1. Place embedment material at the trench bottom with proper allowance for bell joints. Level materials in continuous layers not exceeding 6 inches in compacted depth. Shovel slicing of embedment shall be performed along the sides of the pipe as embedment is placed, to consolidate the bedding and haunching below the pipe.
2. Consolidate granular embedment by rodding, spading and compacting as necessary to provide uniform pipe support and meet the compaction requirement.

3.8 CRUSHED ROCK: Crushed rock shall be placed when shown on the Drawings or specified herein. Crushed rock shall be placed on suitably prepared subgrade and compacted by vibration. Crushed rock shall be kept free from dust, clay or trash. Crushed rock shall be compacted to not less than 90 percent of the maximum density for that material in accordance with ASTM D-1557.

### 3.9 BACKFILLING

- A. General:

1. All trenches and excavations around structures shall be backfilled to finish grade according to the Drawings. Backfill with material as specified herein.
2. Large compaction equipment, including self propelled compaction equipment, bulldozers, loaders, and boom-mounted vibratory plates, shall not be used within 3 feet above the top of pipe, or within 3 feet of new or existing structures.

3. If backfilling operations do not meet the specifications, the material shall be removed, replaced and recompacted at the Contractor=s expense.
  4. Backfill shall not be placed when material is frozen, contains frost, snow, waste material, trees, organic matter and rubbish or when the surface to receive backfill is snow covered or frozen.
  5. No backfill shall be placed over or around any structure until the concrete or mortar has attained a minimum compressive strength of 2,000 psi and can support the loads imposed by backfilling and traffic.
- B. Trench backfill: Backfill for all pipeline trench excavation shall be placed by the end of each working day around all pipe laid that day, leaving only the working end of the pipe uncovered. Any trenches excavated in advance of pipe laying shall also be backfilled at the end of each working day.
1. For trenches beneath proposed structures, slabs, or in areas which have or will have a paved or chip-and-seal surface, or where indicated on the Drawings to use granular fill material:
    - a. Granular fill material shall be shall be placed on the compacted pipe embedment, in layers not to exceed 12 inches in compacted thickness.
    - b. Granular fill material shall be compacted by vibratory means. Each lift of granular fill shall be compacted to a minimum 95 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 2 or minus 2 percent of optimum. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.
  2. For trenches in graveled areas, or other vehicle traveled ways which are neither paved nor surfaced with chip-and-seal material:
    - a. Select fill material shall be placed on the compacted pipe embedment, in layers not to exceed 12 inches in compacted thickness.
    - b. Select fill material shall be compacted to a minimum of 90 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 3 or minus 3 percent of optimum. Select backfill may be compacted by vibratory plates, tracks or wheels of graders, tractors, high loaders or similar equipment, subject to the restrictions above. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.
  3. For trenches in other areas, including grassed areas and parkways which are not in vehicle traveled ways:
    - a. Random fill material shall be placed on the compacted pipe embedment, in layers not to exceed 18 inches in compacted thickness.
    - b. Random fill material shall be compacted to a minimum of 85 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 3 or minus 3 percent of optimum. Backfill may be compacted by vibratory plates, tracks or wheels of graders, tractors, high loaders or similar equipment, subject to the restrictions above. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.
- C. Structure backfill:
1. All structures shall be backfilled to the lines and grades shown on the Drawings. In no instance shall backfill be dumped, bull-dozed or otherwise deposited in bulk upon the structure. Backfill shall be kept at approximately the same elevation on all sides of the structure as backfilling proceeds.
  2. Structure backfill which will be beneath paved areas, slabs, or structures shall be granular fill material, compacted in place to 95% of maximum density as determined by ASTM D-698, at a moisture content within plus 2 or minus 2 percent of optimum. Granular fill shall be placed in lifts not to exceed 8 inches in compacted thickness, and compacted by careful pneumatic or vibratory tamping.

3. Backfill in all other areas shall be select fill material, placed in lifts not to exceed 12 inches in compacted thickness, and compacted in place to 90% of maximum density as determined by ASTM D-698, at a moisture content within plus 3 or minus 3 percent of optimum.

### 3.10 SURFACE RESTORATION

- A. All areas disturbed by construction operations shall be restored by paving, gravel surfacing, or seeding, as indicated on the Drawings and specified. For areas which are seeded, minimum depth of topsoil shall be six inches. Topsoil shall be a dark, friable, organic soil free of clay lumps and rocks larger than one and half inches in largest dimension.

### 3.11 IMPERVIOUS TRENCH CHECK

- A. Trench checks shall be placed where indicated on the Drawings. If a pipeline segment is at least 100 feet but less than 400 feet, one trench check shall be provided in a location acceptable to the Engineer.
- B. Trench checks shall extend the full width of the trench, and the length and depth shall be as indicated on the Drawings. Trench check material shall be placed completely under, around and above pipe, and shall be placed in maximum compacted lifts of 8 inches in thickness and compacted to 95% of maximum density as determined by ASTM D-698. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.

### 3.12 DISPOSAL OF MATERIALS

- A. All unused excess excavated material, together with all debris, removed pipe, stones, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by the Contractor, at the expense of the Contractor.
- B. Material to be disposed of, including excess material, shall be promptly removed from the site by Contractor. If Contractor desires to set aside excess excavated material free from contamination by sewage or other hazardous substances, he shall do so only in an area approved by the Owner.

### 3.13 SOIL TESTING: All materials, for fills and for impervious trench checks (if required), shall be sampled and tested in accordance with Section 01400 - Quality Control.

- A. Laboratory Tests:
  1. Two initial gradation tests and two initial moisture-density (Proctor) tests shall be made for each type of embedment, backfill, and trench check material, including job excavated materials.
    - a. Initial tests on materials which are imported (not job excavated) shall be provided by Contractor and the results submitted as product data for review in accordance with the submittals section.
  2. One additional gradation test and one additional moisture-density test shall be made for each additional 400 tons of imported material, and such tests shall be paid for by Contractor.
- B. Field Tests:
  1. During the progress of the work of filling and backfilling, in-place density tests will be performed with a nuclear density gage by a qualified laboratory technician.
  2. The number of tests to be taken and the locations thereof shall be determined by the Engineer based upon observation of the filling or backfilling process. A minimum of two (2) tests per 100 cubic yards of fill/backfill and two (2) tests per 300 feet of trench will be taken unless otherwise directed by the Engineer. One additional test will be performed on each trench check (if required).

3. If the tests indicate the compaction is not sufficient, the Contractor shall increase the compactive effort on all such inadequately compacted areas.

**END OF SECTION**

## SECTION 02732

### SANITARY SEWER SYSTEM

#### **PART1 GENERAL**

- 1.1 The Contractor shall furnish and install all required sewer piping, fittings, embedment materials, and all accessories for a complete sanitary sewer as shown on the Drawings and specified herein and tested for approval by the Engineer.
- 1.2 SECTION INCLUDES
- A. Sanitary gravity sewer piping, fittings, and accessories.
  - B. Steel Casing.
  - C. Pipe embedment.
  - D. New sanitary sewer manholes and appurtenances
  - E. Gravity sewer acceptance testing.
  - F. Manhole testing
- 1.3 RELATED SECTIONS
- A. Section 02220 - Earthwork & Section 02320 - Earthwork and Trenching.
- 1.4 UNIT PRICE - MEASUREMENT AND PAYMENT
- A. Payment: Payment will be made at the respective unit or lump sum price listed in the Bid Form.
- 1.5 REFERENCES
- A. Midwest Concrete Industry Board (MCIB) Standard Specification for Concrete Work.
  - B. ASTM A-48 Gray Iron Castings
  - C. ASTM A-139 Specifications for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
  - D. ASTM A-615 Deformed And Plain Billet-Steel Bars For Concrete Reinforcement
  - E. ASTM C-32 Sewer And Manhole Brick (Made From Clay Or Shale)
  - F. ASTM C-270 Mortar For Unit Masonry
  - G. ASTM C-478 Precast Reinforced Concrete Manhole Sections
  - H. ASTM C-923 Specification For Resilient Connectors Between Reinforced Concrete Manhole Structures And Pipes
  - I. ASTM D-698 Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures

- J. ASTM D-1784 Rigid Poly (Vinyl Chloride) Compounds And Chlorinated Poly (Vinyl Chloride) Compounds
- K. ASTM D2241 Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
- L. ASTM D-2321 Recommended Practice For Underground Installation Of Flexible Thermoplastic Sewer Pipe
- M. ASTM D-2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
- N. ASTM D-2837 Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials.
- O. ASTM D-3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
- P. ASTM D-3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- Q. ASTM D-3212 Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals.
- R. ASTM F-477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- S. ASTM F-1417 Standard Test Method for Installation Acceptance of Plastic Sewer Lines Using Low-Pressure Air.
- T. ANSI/AWWA C-206 Standard for Field Welding of Steel Water Pipe.
- U. AWWA C-900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. for Water Distribution

#### 1.6 DEFINITIONS

- A. Embedment: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

#### 1.7 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittals.
- B. Product Data for Review:  
Pipe, pipe accessories, fittings,  
Manholes, castings, manhole appurtenances.  
Pressure gauge certification and calibration data.
- C. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### 1.8 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Section 01700 - Contract Closeout.
- B. Record location of pipe runs, connections, and invert elevations.

- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### 1.9 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and ordinances for disposal of debris and burning of debris on site.
- B. Contractor shall notify utility companies prior to commencement of construction and coordinate work with utilities as required.

#### 1.10 FIELD MEASUREMENTS

- A. Verify that field measurements and elevations are as indicated on the Drawings.

#### 1.11 COORDINATION

- A. Coordinate sanitary sewer construction with other work.

### **PART 2 PRODUCTS**

#### 2.1 PIPE MATERIALS

- A. Gravity sewer mains and service laterals: Shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds, and ASTM D-3034 for polyvinyl chloride (PVC) sewer pipe. Minimum wall thickness shall conform to Standard Dimension Ratio 26 (SDR 26). The Contractor shall install the maximum pipe lengths manufactured by the supplier.

Joints: Flexible gasketed joints for PVC pipe and fittings shall be compression type joints with the gasket confined in either the spigot or the bell end of the pipe. Rubber gasket rings shall be neoprene or other synthetic material and conform to ASTM D-3212 and ASTM F-477. Natural rubber gaskets will not be acceptable.

Fittings: Shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds, and ASTM D-3034 for polyvinyl chloride (PVC) sewer fittings. Fitting joints shall be bell and spigot with elastomeric gaskets, unless indicated on the Drawings to be solvent cemented joints, in which case the joint shall conform to ASTM D-2855. Fittings shall not be used unless directed by the Engineer or indicated on the Drawings.

- B. Polyvinyl Chloride Plastic Pressure Pipe and Fittings (SCH 80 PVC): PVC pressure piping shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds, and ASTM D-1785 for Schedule 80 PVC pipe.
  1. Fittings shall be solvent welded socket-type, in accordance with ASTM D-2467. Threaded fittings in accordance with ASTM D-2464, shall be used only where indicated on the Drawings or specifically allowed by the Engineer.
  2. Primer and solvent cement shall conform to ASTM F656 and ASTM D2564, respectively.
  3. Flange adapters shall be socket-type solvent welded, with diameter and drilling conforming to ANSI/ASME B16.5, Class 150. Flange gaskets shall be full face, chemical resistant elastomeric material. Flange bolts shall be ASTM Grade B, galvanized or stainless steel.
- C. Polyvinyl Chloride Plastic Pressure Rated Pipe and Fittings (ASTM D-2241): Shall meet the requirements of ASTM D-1784 cell classification 12454-A or 12454-B for PVC compounds, and

ASTM D-2241 for poly vinyl chloride (PVC) plastic pipe (SDR-PR).

1. Minimum wall thickness shall conform to Dimension Ratio 21, for Class 200.
2. The Contractor shall install the maximum pipe lengths manufactured by the supplier.
3. Joints: Joints shall be push-on type with integral bell and spigot and elastomeric gaskets meeting the requirements of ASTM D-2122. An integral wall-thickened bell end or an integral sleeve-reinforced bell end will be acceptable. Rubber gasket rings shall be neoprene or other synthetic material and conform to ASTM F-477. Natural rubber gaskets will not be acceptable.
4. Fittings: Fittings shall be PVC with same DR rating, cell classification, and gasket design as pipe.
5. Fitting Restraint: Shall be concrete thrust blocks as indicated on the Drawings.

D. Steel casing: Steel casings for bored, jacked or open trench construction shall be steel pipe conforming to ASTM A 139 with a minimum diameter as shown on the Drawings.

1. Minimum wall thickness shall be in accordance with the following table:

Casing - Inches	Nominal Wall Thickness - Inches	
	Under Railroads	All Other Uses
8-16	0.312	0.188
18	0.312	0.250
20	0.375	0.250

2. Steel shall be Grade B under railroads and Grade A on all other uses.
3. Steel pipe shall be have welded joints in accordance with AWWA C 206

E. Casing Spacers: Casing spacers shall be used with all casing. Casing spacers shall have a minimum of 4 runners and shall hold the carrier pipe in the center of the casing. Casing spacers shall have lined stainless steel sleeve and UHMW plastic runners, and shall be Cascade Waterworks Mfg. "Model CCS" or Advance Products & Systems, Inc. "Model SSI", or equal.

F. Casing End Seals: Ends shall be sealed with synthetic rubber, wrap-around end seals with stainless steel bands, Cascade Waterworks Mfg. "Model CCES" or Advance Products & Systems, Inc. "Model AW", or equal.

G. Restrained Joint PVC (for directional bore): Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to ASTM D2241. The restrained joint pipe system shall also meet all short and long term pressure test requirements of ASTM D2241. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4°F, in accordance with the requirements of ASTM D2837.

Restrained joint PVC pipe products shall have been tested and approved by NSF International. 2" through 16" PVC pipe and coupling systems up to Class 250 shall be listed in NSF14. All products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF 61 by an acceptable certifying organization.. Copies of agency approval reports or product listings shall be provided to the Engineer.

Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision-machined grooves in the pipe and coupling to provide full 360° restraint with evenly distributed loading.

Couplings shall be designed for use at or above the rated pressures of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

Pipe shall be joined utilizing an integral bell system that does not require couplings. A high-strength, flexible thermoplastic spline shall be inserted into mating, precision-machined grooves in the pipe and integral-bell to provide full 360° restraint with evenly distributed loading. Integral bell shall incorporate an elastomeric sealing gasket meeting the requirements of ASTM F477. Joints shall be designed to meet the leakage test requirements of ASTM D3139.

- H. HDPE pipe (for directional bore): Minimum HDPE SDR 11 for pipe 2” to 24” and SDR 9 for pipe sizes 1” and ¾” meeting the requirements of AWWA C906, ASTM F714 and ASTM D3035. HDPE pipe shall have a co-extruded green cover or extruded green stripes designating use for sanitary sewer. All fittings shall be molded, Butt heat fusion or electro-fusion fittings.

## 2.2 PIPE ACCESSORIES

- A. Banded Couplings: Banded couplings for gravity sewer piping shall be synthetic rubber repair couplings with stainless steel clamping ring bands, BANDSEAL by Dickey, Fernco coupling or approved equal. Banded couplings shall be provided to transition between different materials and sizes as required.
- B. Pipe grouting rings: Pipe grouting rings shall be synthetic rubber, with stainless steel take-up clamps. Ring and clamps shall meet or exceed the requirements of ASTM C-923. Grouting rings shall be matched to the outside diameter of the carrier pipe. Grouting rings shall be Press-Seal Gasket Corporation “WS Series WaterSTOP Grouting Rings” or approved equal.
- C. Connection saddles: Connection saddles for connection of sewer laterals and service connections to PVC sewer pipe shall be rigid, banded, saddle type fittings of PVC plastic with a neoprene or synthetic rubber gasket.
- D. Flange Adapters: Flange adapters shall be the cast iron slip-on type retained by set screws. Flange body shall be ductile iron, ASTM A-536, Grade 65-45-12. Set screws shall be manufactured from AISI 4140 steel, heat treated to Rockwell C 42-50 and zinc plated. Set screws shall have break away torque heads. Flange adapters shall conform to ANSI B16.1 for machining and drilling. Gaskets shall be standard mechanical joint gaskets, EPDM or Buna-N. All non-plated ferrous metal parts shall be shop primed with an epoxy primer, for finish painting in the field. Flange adaptors shall be Ford Meter Box Corporation “UNI-Flange Series 200” or equal.
- E. Mechanical couplings: Mechanical couplings shall be gasketed, sleeve-type, sized to properly fit the pipes to be joined, with steel or ductile iron middle ring, steel or ductile iron follower rings, and synthetic rubber gaskets. Gaskets shall be SBR, Buna-N, or EPDM. All ferrous metal surfaces shall be shop coated with an epoxy coating for corrosion resistance. All hardware shall be 300 series stainless steel. Mechanical couplings shall be Ford Meter Box “Style FC1, Style FC2A, Style FC3, or Style FC23”, Dresser “Style 38 or Style 162”, Rockwell “441 or 411”.

## 2.3 EMBEDMENT

- A. Embedment material for Forcemain construction shall be Select Backfill as approved by Engineer.

- B. Concrete Encasement: Where indicated on the Drawings, concrete encasement shall be provided instead of the pipe embedment classes specified herein. Requirements for concrete encasement are detailed on the Drawings. Concrete and reinforcement shall be as specified in Section 03300, for 3000 psi concrete.

#### 2.4 BACKFILL MATERIALS

- A. Backfill materials shall be as specified in Section 02220 - Earthwork & Section 02320 - Earthwork and Trenching.

#### 2.5 MANHOLE MATERIALS: Manhole materials shall conform to the details on the Drawings, and to the following:

- A. Precast manholes: New manholes shall be constructed of precast concrete with developed base (DB) or precast concrete with cast-in-place (CIP) base.
  - 1. Precast concrete manholes with CIP base: The precast concrete manholes shall conform to ASTM C-478. All concrete shall be 4000 psi with Type II cement. Joints between the riser sections shall be a double gasketed joint of joint sealant material. Where possible, pipe openings for pipe connections shall be furnished with cast-in-place flexible entrance seals. Otherwise, pipe connections for pipes grouted in place shall be made using pipe grouting rings. Boxouts for grouting shall have surfaces grooved or roughened to improve grout bond.
  - 2. Precast concrete manholes with developed base: The precast concrete manhole shall conform to ASTM C-478. All concrete shall be 4000 psi with Type II cement. The developed base shall be poured monolithic with the bottom riser section. The base reinforcement shall be continuous with the reinforcement of the bottom riser section. Joints between the riser sections shall be a double gasketed joint of joint sealant material. Pipe openings shall be furnished with cast-in-place flexible entrance seals.
- B. Adjusting rings: Adjusting rings shall be precast concrete, with circumferential reinforcement per ASTM C-478.
- C. Lifting notches: Precast sections may be provided with lifting notches on the inside faces of walls to facilitate handling, Lifting notches shall be not more than 3 inches deep. Holes extending through a wall will not be acceptable.
- D. Flexible entrance seals: Cast-in-place flexible entrance seals shall be "A-LOK" flexible seals manufactured by A LOK Products Incorporated, "Press Wedge II" manufactured by Press-Seal Gasket Corporation or equal.
- E. Castings: Manhole rings and lids shall be constructed of gray cast iron conforming to ASTM A-48. Castings for standard manholes shall be Clay and Bailey Model No. 2007 or approved equal with "Sewer" cast on the lid. Castings for shallow manholes shall be Clay and Bailey Model No. 2002 or approved equal with "Sewer" cast on lid.
- F. Protective coating: The protective coating for the exterior of manholes shall be Koppers Company, Inc. Bitumastic No. 50, Tnemec Company, Inc. asphalt base foundation coat or equal. Precast manholes shall be shop coated. Manholes used for pump station wetwells shall be coated on the inside and outside.
- G. Joint sealant: Joint sealant material used for sealing the joint between the manhole frame and chimney or corbel/cone section, shall be preformed butyl rubber mastic joint sealant, BIDCO C-56 or Press Seal Gasket Corporation (EZ-STIK) or equal.

- H. Crushed stone: Crushed stone material used as a foundation and for leveling of manholes shall be as specified for granular pipe embedment material.
- I. Concrete brick: Concrete brick shall conform to the requirements for ASTM C-55, Grade N-I, moisture controlled for linear shrinkage of 0.03 percent or less.
- J. Repair Mortar: Repair mortar for grouting pipes, brick work, and making structural repairs to manholes shall be a one-component, shrinkage-compensated, cement based product. Repair mortar shall have a low permeability and be freeze/thaw durable and resistant to chlorides and sulfates. Repair mortar shall be a single-component product requiring only the addition of potable water for mixing. Repair mortar shall have a minimum compressive strength of 3,800 psi at 1 day and 11,000 psi at 28 days.
  - 1. For hand application: Master Builders "Emaco S88-CI" or approved equal.
  - 2. Pourable or pumpable: Master Builders "Emaco S77-CR" or approved equal.
- K. Manhole Steps: Shall be Grade 60 1/2" diameter steel reinforcing rod which is fully encapsulated in black polypropylene, with serrated tread surfaces and tall end lugs to prevent slippage, and conforming to ASTM C-478 Manhole steps shall be driven into the manhole wall and anchored using a press fit. Steps shall be approximately 15 inches wide with a stand-off of 6 inches. Manhole steps shall be M.A. Industries "PS2-PF Manhole Step", or equal.

**PART 3 EXECUTION**

3.1 EXAMINATION

- A. Verify that the sewer pipeline lines and grades are as shown on the Drawings.

3.2 PREPARATION

- A. The Contractor shall verify the location and depth of all utilities a minimum of 24 hours prior to construction. The Contractor may utilize the toll free number for the "Missouri One Call System, Inc" 1-800-DIG-RITE. This number is applicable anywhere within the state of Missouri. Prior to commencement of work the Contractor shall notify all those companies which have facilities in the vicinity of the construction.

3.3 PROTECTION

- A. Locate, identify, and protect utilities that remain, from damage. The Contractor shall make every reasonable effort to protect all existing utilities from damage. If any utility is damaged through the carelessness or neglectful actions of the Contractor, the utility shall be repaired by its owner at the Contractor's expense.
- B. Relocation of an existing utility which is within the public right-of-way shall be performed by the respective utility owner at no cost to the Contractor. Relocation and protection of an existing utility which is within a utility easement shall be the responsibility of the Contractor.
- C. Any private facilities damaged or disturbed by the Contractor's work shall be repaired by the Contractor prior to close of the working day. Repairs shall be made in a manner sufficient to restore utility service to that property.
- D. Protect trees, plant growth, and features designated to remain as final landscaping.

- E. Protect all property or lot corner pins, right of way markers and stakes from damage or displacement during construction. Any property or lot corner pins, right of way monuments, and/or public land corner monuments that must be temporarily removed shall be properly referenced by a Missouri registered professional land surveyor prior to removal, and reset by the professional land surveyor upon completion of the project. The Contractor is responsible for surveying costs for these services.
- F. Protect from damage or displacement all project benchmarks and existing structures within or adjacent to the construction limits that are not to be removed or demolished.

### 3.4 SEPARATION OF WATER AND SEWER UTILITIES

- A. GRAVITY SANITARY SEWERS - When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 ft (3.0 m). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 ft. (3.0 m) separation, the Engineer will consult with MDNR to consider equivalent protection by other methods.
  - 1. When a water pipe and a sanitary sewer cross and the sewer is 2 ft (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the Engineer will consult with MDNR to consider equivalent protection by other methods.
- B. SEWER CONNECTIONS - There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.
- C. SEWER MANHOLES - No water pipe shall pass through or come in contact with any part of a sewer manhole.
- D. STORM SEWERS - The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main, if encountered, shall be determined by the Engineer based on geotechnical considerations. Required separation distances between water mains and combined storm/sanitary sewers are equivalent to those for water mains and gravity sanitary sewers.
- E. DRAINS - Underground drains from fire hydrants or valve pits should not be directly connected to sanitary or storm drains.

### 3.5 EMBEDMENT

- A. Trenching and backfill for pipe trenches shall be according to Section 02220 - Earthwork & Section 02320 - Earthwork and Trenching, and the details on the Drawings.
- B. Embedment for PVC pipe shall extend 4 inches below the pipe to 12 inches above the top of pipe, and shall be the full width of the trench. Embedment over rock shall be an additional 2 inches below the pipe.
- C. Place embedment material at the trench bottom with proper allowance for bell joints. Level materials in continuous layers not exceeding 4 inches in compacted depth. Shovel slicing of embedment shall be performed along the sides of the pipe as embedment is placed, to consolidate the bedding and haunching below the pipe.
- D. Where granular embedment is required, consolidate granular embedment by rodding, spading and

compacting as necessary to provide uniform pipe support.

- E. Where granular embedment is required, each lift of granular embedment material shall be compacted to a minimum 90% of maximum density as determined by ASTM D-698.
- F. Where shown on the Drawings, concrete encasement shall be provided instead of pipe embedment.

### 3.6 PIPE INSTALLATION

- A. All pipe shall be protected during transport, storage and installation from shock and free fall. Pipes shall be installed without cracking, chipping, breaking, bending or damaging the materials. Damaged pipe shall be replaced with new materials except when repairs are permitted by the Engineer. Use slings, lifting lugs, hooks and other protection devices during handling. A double sling shall be required when handling plastic pipe 10 feet or longer.
- B. Install pipe of the size, material, strength class, and joint type as specified or indicated on the Drawings.
- C. Install gravity pipelines beginning with the lowest point of the pipeline and install pipe with the spigot or tongue end down stream. Install pressure pipelines with the bell ends facing the direction of laying, except when reverse laying is specifically authorized by the Engineer.
- D. Install pipe to the line and grades indicated on the Drawings. Maximum slope variation from true slope shall be one inch between structures for gravity sewers. The maximum variation from alignment between structures shall be three inches. Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM C-425, D-2321 & ANSI/AWWA C600 as applicable. Only one correction for alignment and/or grade shall be made between structures. The Contractor shall establish such grade control devices necessary to maintain the specified tolerance. All pipe shall have a continuous slope free of depressions.
- E. Pipe installation shall be in accordance with applicable standards, such as ASTM C-12, D-2321 and ANSI/AWWA C600, except where conflicts with this section occur, in which case this section shall govern.
- F. Clean the interior of all pipe fittings and joints prior to installation. Protect pipe against the entrance of debris and foreign matter during discontinuance of installation and at the close of the working day by installing a close fitting plug at the open end. Plugs shall be water tight against heads up to 20 feet of water.
- G. The Contractor shall take whatever means necessary to keep the trenches free of water and as dry as possible during pipe installation, bedding and jointing operations.
- H. After each pipe has been brought to grade, aligned and placed in final position, place sufficient embedment material under the haunches and on each side of the pipe to hold the pipe in proper position during subsequent pipe jointing, bedding and backfilling operations. Compact embedment material to 90 percent maximum density by rodding, spading, or using suitable compaction equipment. Place embedment material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
- I. Pipe Jointing: Locate joints to provide for differential movement at changes in type of embedment, concrete collars and encasement and structures. Sewer main jointing shall be according to the following specifications:
  - 1. Clean and lubricate all joint and gasket surfaces as recommended by the manufacturer.

2. Examine all materials prior to installation for soundness and compliance with specifications.
  3. Check joint position and condition after assembly prior to installing additional pipe sections.
  4. Check joint opening and deflection for specification limits.
- J. Pipe cutting shall be performed in a neat and workmanlike manner without damage to the pipe. Main taps for service saddle tees shall be made with a tapping tool specifically designed for that purpose. Cut edges shall be smoothed by power grinding to remove burrs and shape edges.
- K. Pipe connection to structures:
1. Pipe connection to new structures shall be as shown on the Drawings. Where not shown on the Drawings, pipes shall be connected to new structures using flexible entrance seals.
  2. Pipe connection to existing structures shall be made with two inches clearance surrounding the pipe or fitting. PVC pipe shall be fitted with a grouting ring. The opening between the pipe and structure shall be filled with patching material to form a water tight seal.
  3. Pipe connections to existing manholes shall be made in such manner that the finish work will conform to the essential applicable requirements specified for new manholes, including all necessary concrete work, cutting and shaping. When new sewer piping is connected to an existing manhole, manhole benches and invert shall be repaired using patching material, as specified herein.

### 3.7 REQUIREMENTS FOR PIPE JOINTS:

Pipe joints shall be carefully and neatly made, in accordance with the requirements which follow.

- A. Threaded: Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.
1. Threaded joints, in plastic piping, shall be made up with Teflon thread tape applied to all male threads. Threaded joints, in stainless steel piping, shall be made up with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer or a suitable joint compound.
- B. Flared: Ends of annealed copper tubing shall be cut square, and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required, to produce leak-tight connections.
- C. Solvent Welded: All joint preparation, cutting and jointing operations shall comply with the pipe manufacturer's recommendations and ASTM D-2855. Pipe ends shall be beveled or chamfered to the dimensions recommended by the manufacturer. Pressure testing, of solvent welded piping systems, shall not be performed until the applicable curing time, set forth in Table X2.1 of ASTM D-2855, has elapsed.
- D. Flanged: Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Connecting flanges shall have similar facings, i.e., flat or raised face.
- E. Welded: Welding shall conform to the specifications and recommendations contained in the "Code

for Pressure Piping", ANSI B31.1. The following requirements shall also apply for stainless steel piping:

1. High purity inert welding gases and cover gases shall be used. Weld surfaces shall be silvery, light gold or straw color at worst, after welding. Black welds are not acceptable.
  2. Prior to welding, all surfaces shall be clean and free of all organic materials, moisture and dirt.
  3. Welds shall be dressed using aluminum oxide grinding wheels. Silicon carbide is not acceptable.
- F. Push-on: Gasket installation and other jointing operations shall be in accordance with the recommendations on the manufacturer. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with a heavy vegetable soap solution immediately before the joint is completed. Lubricant shall be suitable for use in potable water, shall be stored in closed containers, and shall be kept clean.

### 3.8 PIPE ACCESSORIES

- A. Mechanical couplings: Mechanical couplings shall be carefully installed in accordance with the manufacturer's recommendations. Pipe ends shall be separated by a space of at least 1/4 inch but not more than 1 inch. Pipe and coupling surfaces which contact gaskets shall be clean and free from dirt during assembly. Following installation of the coupling, damaged areas of shop coatings on the pipe and couplings shall be repaired.
- B. Wall Pipes: Where wall pipes with flanged or mechanical joint ends are installed, the bolt holes in the bell of the wall pipe shall straddle the top centerline of the casting. The top centerline shall be marked on the wall pipe at the foundry.

### 3.9 STEEL-CASINGS FOR BORED OR JACKED CROSSINGS

- A. Installation of steel casing shall be performed by a person experienced in such work. Casing shall be installed by a combination of augering and jacking. Alignment and gradient shall be such that the carrier conduit can be installed to the line and grade shown on the Drawings.
- B. Welding shall be performed by a person experienced with the type of welding necessary. All welds shall conform to AWWA C 206.
- C. After completion of the installation of the casing, the carrier conduit shall be carefully pushed or pulled through the casing in a manner that will maintain proper jointing of the pipe joints and provide the required gradient and alignment. Casing spacers shall be provided.
- D. Casing Spacers: Casing spacers shall be installed per approved manufacturer's printed recommendations, or at 10 foot spacing, whichever provides greater support. Casing spacers are required at each end of casing. Spacers shall have runners attached to the shell and be designed to provide a minimum of 0.75 inches clearance between the carrier pipe's greatest outside diameter and the casing pipe's inside diameter.
- C. Air Testing: Casing pipes shall be air pressure tested APWA Standard Specifications Section 2509.4.2.c, prior to the placing of the end seals.

### 3.10 JOINT RESTRAINT FOR PRESSURE PIPING:

Joint restraint shall be provided for portions of buried piping which will serve in a pressure flow application, including: force mains, water lines, and pump discharge lines.

- A. Joint restraint for SDR-PR piping shall be accomplished using concrete thrust blocks as indicated on the drawings. Thrust blocks shall be poured against undisturbed earth. Where possible, joints and pipe should be deflected to eliminate the need for fittings.
- 3.11 MANHOLES: Manholes shall be constructed of precast concrete sections, with cast iron frames and covers in accordance with the Drawings and as specified herein.
- A. Handling: Precast concrete sections shall be handled carefully and shall be protected during transport, storage and installation from shock and free fall. Hooks shall not be permitted to come into contact with joint surfaces. Damaged sections shall be replaced with new sections, except when repairs are permitted by the Engineer.
  - B. Inspection: Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.
  - C. Manhole construction
    - 1. Precast concrete manholes with CIP base: Construct manhole with precast concrete section on a cast-in-place concrete foundation slab as shown on the drawings. Pipe connection to the manholes shall be made with cast-in-place flexible entrance seals as specified herein or by placing a tight fitting rubber gasket around the outside of the pipe where the pipe enters the manhole and then filling the void between the gasketed pipe and the manhole wall with patching material. Joint seals between each riser section shall be installed in strict conformance with manufacturer's recommendations. Damaged exterior coating shall be field touched up prior to backfilling.
    - 2. Precast concrete manholes with a developed base: Precast manholes with a developed base shall be placed on a base of crushed stone as detailed on the drawings. Crushed stone shall be granular embedment material as specified herein. The crushed stone base shall be graded smooth, level and to the correct grade. The bottom riser section shall be placed upon the crushed rock base and checked for alignment, elevation and plumbness. If not correct, the bottom riser section shall be completely removed from the excavation and the crushed stone base reshaped. Pipe connections to the manholes shall be in strict conformance with manufacturer's instructions for installation of the flexible entrance seals. Joint seals between each riser section shall be installed in strict conformance to manufacturer's recommendations. Damage to exterior coating shall be touched up in the field prior to backfilling.
  - D. Inverts: The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section.
    - 1. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.
    - 2. The floor of the manhole outside the channels (the bench) shall be smooth and shall slope toward the channels not less than 1 inch per foot nor more than 2 inches per foot.
    - 3. Invert channels shall be formed in the field using either concrete mix as specified in Section 03300 - Miscellaneous Concrete, or concrete brick and mortar as specified herein. Where concrete brick and repair mortar used, repair mortar shall be placed completely around each brick to a minimum thickness of 3/8 inch. Manhole inverts formed directly in the concrete of the manhole base of developed-base manholes will not be acceptable.
  - E. Flexible entrance seals: Where cast-in-place flexible entrance seals are used to seal pipe connections to new manholes, the concrete or mortar of the field-installed invert shall extend exactly half-way up the pipe, to the springline. No concrete or mortar shall be placed around the

pipe on the exterior of the manhole.

- F. Frames and covers: Unless shown otherwise on the drawings, all castings shall be set flush with finish grade.

### 3.12 GRAVITY SEWER ACCEPTANCE TESTING

- A. All new sewer segments which extend from manhole to manhole will be subject to acceptance testing under this subpart. Partial sewer main segment replacements and point repairs will not be tested under this subpart.
- B. Visual Inspection:
  - 1. Clean pipe of excess mortar, joint sealant, dirt and debris prior to inspection.
  - 2. Inspect the sewer by lamping the pipeline between manholes to determine the location of any misaligned, displaced or broken pipe and any visible infiltration or defects. In large pipes where space permits, the visual inspection may be made by physical passage.
  - 3. Correct defects as required prior to conducting leakage tests.
- C. Air Leakage Test:
  - 1. Contractor shall perform air leakage tests for all pipe sizes.
  - 2. Notification: Contractor shall notify Engineer at least 48 hours in advance the scheduled time for testing. Resident Project Representative shall be present for acceptance testing and approval.
  - 3. Contractor shall provide all necessary equipment for performance of the air leakage test, including but not limited to piping connections, pipe plugs with taps, test pumping equipment, pressure gauges, bulkheads and regulators to avoid over pressurization. The equipment and gauges shall meet the minimum specifications set forth in ASTM F-1417: "Standard Test Method for Installation Acceptance of Plastic Sewer Lines Using Low-Pressure Air". The air equipment shall consist of necessary valves and pressure gauges to control an oil-free air source and the rate at which air flows into the test section to enable monitoring of the air pressure within the test section.
  - 4. Gauge certification from the manufacturer and calibration data shall be required for all pressure test gauges, a copy of which will be made available to the Engineer at the time the air tests are performed.
  - 5. Test each reach of pipe between manholes after completion of pipe and appurtenance installation and trench backfill.
  - 6. Plug ends of sewer line at manholes and cap or plug all lateral connections to withstand internal pressure. One plug shall have two taps for connecting equipment. After connecting air control equipment to the air hose, begin increasing the air supply within the pipe section, monitoring the air pressure so that the internal pressure does not exceed 6.0 psig.
  - 7. After the internal pressure reaches 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least two minutes in order to reach equilibrium between air temperature and pipe walls. During this time, check all plugs for leaks. If leaks are found, bleed off air, tighten plugs and begin increasing the air supply again.
  - 8. Air testing shall take place by the Time-Pressure Drop Method. Decrease the pressure to 3.5 psig and begin timing to determine the time required to achieve a pressure drop from 3.5 to 2.5 psig. If the time, in seconds, to achieve the 1.0 psig pressure drop is greater than that shown in the following table, the line is presumed free of defects. For pipe sizes and lengths other than those shown in the table below, refer to ASTM F 1417.

Required Time for Length up to Length Indicated, min:sec
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Pipe	up to 100 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.
6" &	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10"	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12"	11:20	11:24	14:15	17:05	19:56	22:47	25:38

If the air test fails to meet the requirements, repair the defects and retest the line. All constructed sewer lines shall pass the low pressure air test prior to acceptance. In areas where ground water is known to exist, a ½ inch diameter , 10 inch long, capped pipe nipple shall be installed at the top of the pipe through the manhole wall during installation. Immediately prior to performing the acceptance test, the ground water level shall be determined by connecting a clear plastic tube into the nipple and holding vertically until the water level stops rising. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to the test readings.

D. Deflection Test for Flexible Sewer Pipe:

1. Prior to final acceptance, the Contractor shall perform a diametrical deflection test on all flexible and semi-flexible pipe (such as PVC and HDPE plastic pipe), for both open cut and trenchless construction. Tests shall be conducted between manholes or structures. Deflection testing of a segment of sewer shall occur at least thirty (30) days after the pipe has been installed and completely backfilled.
2. A mandrel with a diameter equal to 95 percent of the inside diameter of the pipe to be tested shall be used. The mandrel shall be cylindrical in shape and constructed with nine evenly spaced arms or prongs. Mandrels with fewer arms will be rejected as not sufficiently accurate. The mandrel shall be approved by the Engineer prior to testing pipe of each given size. The Contractor shall furnish proving rings for verifying the mandrel diameter. Contact length between points of contact on the mandrel arm shall be as follows:

Nominal Pipe Diameter, inches	Mandrel length, inches
6 and 8	8
10	10
12	10
15	12
18	15

3. The maximum allowable deflection shall be five (5) percent of the inside pipe diameter.

Allowances for pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the maximum allowable dimension of the mandrel, but shall be counted as part of the five (5) percent or lesser deflection allowance.

4. The mandrel shall be hand-pulled by the Contractor through all flexible sewer lines. Any section of sewer failing the diametrical deflection test shall be repaired or replaced by the Contractor at no cost to the Owner, and retested.

### 3.13 PRESSURE PIPING ACCEPTANCE TESTING

- A. All new sewer force mains and pressure process piping will be subject to hydrostatic pressure testing under this subpart. Force mains and pressure sewers shall be tested from the point of discharge to the isolation valves in the corresponding lift station(s). New segments of pipelines which will be connected to existing lines shall be pressure tested prior to connection.
- B. Notification: Contractor shall notify Engineer at least 48 hours in advance of the scheduled time for testing. Resident Project Representative shall be present for acceptance testing and approval.
- C. Test Conditions:
  1. Test procedure shall be according to AWWA C 600 Section 4.1
  2. Test pressure shall be 100 psi (gauge). This pressure will not exceed the thrust-restraint design pressure.
  3. The hydrostatic test shall be of at least a 2-hour duration. Test pressure shall not vary by more than +5 psi for the duration of the test.
- D. Test materials: Contractor shall supply all of the necessary plugs, hose, riser pipe, pumps, gauges, and other equipment as required for the testing. The Contractor shall obtain permission from the Owner for use of City water supply from an existing fire hydrant.
- E. Pressurization: After the pipe has been laid and backfilled, the section of pipe shall be isolated. The pipe shall be slowly filled with water. Before applying the specified test pressure, air shall be expelled completely from the section of piping under test. If permanent air vents are not located at all high points, corporation cocks shall be installed at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place as directed by the Engineer. The specified test pressure (based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge) shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system will be allowed to stabilize at the test pressure before the leakage test is conducted.
- F. Examination: All exposed pipe, fittings, valves, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained.
- G. Leakage: Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time. Allowable leakage shall be as follows, per AWWA C 600.

Pipe Size (inches)	Allowable Loss (@ 100 psig) (gallons per hour per 1000 feet)
3	.23
4	.30
6	.45
8	.60
10	.75
12	.90
14	1.05
16	1.20
18	1.35

- H. Acceptance of Installation: Acceptance shall be determined on the basis of allowable leakage. If any test of pipe discloses leakage greater than that specified above, repairs or replacements shall be accomplished in accordance with the specifications. All visible leaks shall be repaired regardless of the amount of leakage.

### 3.14 MANHOLE TESTING

- A. Manhole leakage test: All new manholes shall pass a vacuum leakage test.
- B. Notification: Contractor shall notify Engineer at least 48 hours in advance the scheduled time for testing. Resident Project Representative shall be present for acceptance testing and approval.
- C. Pre-Test Inspection: All precast concrete manholes shall be visually inspected to determine the presence of misaligned, displaced, broken manhole sections or other physical defects. All defects shall be satisfactorily corrected prior to conducting vacuum leakage tests.
- D. Each manhole shall be tested immediately after assembly and prior to backfilling. All lifting holes shall be plugged with patching material. No standing water shall be allowed in the excavation during testing.
- E. Vacuum testing procedure: All pipes entering the manhole shall be plugged, taking care to securely brace the plugs from being drawn into the manhole. The test head shall be placed at the inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine inches. The manhole shall pass if the time is greater than 60 seconds for a 48-inch diameter manhole, 75 seconds for 60 inches, and 90 seconds for 72 inches. If the manhole fails the initial test, necessary repairs shall be made with patching material, as specified herein, while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained. If the joint mastic or gasket is displaced during the vacuum testing, the manhole shall be disassembled, the seal replaced and the manhole retested.

### 3.15 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400 - Quality Control.
- B. Compaction and soil testing will be performed in accordance with Section 02220 - Earthwork & Section 02320 - Earthwork and Trenching.

**END OF SECTION**

## SECTION 02831

### CHAIN LINK FENCING

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Fence framework, fabric and accessories.
- B. Excavation for post bases; concrete foundation for posts and center drop for gates.
- C. Manual gates and related hardware.

##### 1.2 RELATED SECTIONS

- A. Section 02220 - Earthwork and Trenching

##### 1.3 REFERENCES

The following publications form a part of these specifications to the extent indicated by references thereto. The revision in effect at the time of the Bid Opening shall be applicable. If these publications conflict with the requirements of this section, the section requirements shall govern.

American Society for Testing Materials (ASTM):

- 1. A-120 - Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.
- 2. A-121 - Zinc-Coated (Galvanized) Steel Barbed Wire.
- 3. A-392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- 4. A-491 - Aluminum-Coated Steel Chain-Link Fence Fabric.
- 5. A-500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- 6. A-569 - Steel, Carbon, Hot-Rolled Sheet and Strip Commercial Quality.
- 7. A-501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- 8. A-585 - Aluminum-Coated Steel Barbed Wire.

##### 1.4 SYSTEM DESCRIPTION

- A. Fencing: Fencing shall conform to the requirements indicated on the Drawings and as specified herein.
  - 1. Fencing shall generally consist of galvanized or aluminum-coated steel fabric, with a top rail, bottom tension wire and three strands of barbed wire mounted on 45-degree extension arms.
- B. Fabric Height: 6 feet nominal.
- C. Barbed Wire: The upper strand of barbed wire shall be approximately 12 inches out from the fence and 12 inches above the top of the fabric.
- D. Line Posts: Posts shall be set in concrete. Unless otherwise indicated on the Drawings, posts shall be spaced approximately 10 feet apart.

## 1.5 SUBMITTALS

- A. Product Data for Review: Complete detail drawings and specifications, for the fence and accessories, shall be submitted in accordance with Section 01300 - Submittals.
- B. Manufacturer's Installation Instructions: Indicate installation requirements.

## 1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01700 - Contract Closeout.
- B. Accurately record actual locations of property perimeter posts relative to property lines and easements.

## 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's instructions.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

## 1.9 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on shop drawings.

## PART 2 PRODUCTS

### 2.1 MATERIALS: Fence components shall be as follows:

- A. Framing (Steel): ASTM A-569; hot-rolled steel strip, cold-formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi (345 MPA).
- B. Fabric Wire (Steel): 6-gauge, 2-inch mesh; galvanized ASTM A-392 Class 2, or aluminum-coated ASTM A-491; knuckled selvage on top, barbed selvage on bottom.
- C. Barbed Wire: Galvanized, ASTM A-121, Class 2 or aluminum-coated ASTM A-585, Type I; two 12½-gauge steel wires, with 4-point barbs.
- D. Posts: Steel pipe, ASTM A-120, standard weight (Schedule 40).

### 2.2 COMPONENTS

- A. Line Posts: 2-inch Ø pipe, 3.65 lb. per ft.; or 2-inch square, 3.85 lb. per ft.
- B. Corner and Terminal Posts: 2.5-inch Ø pipe, 5.79 lb. per ft.
- C. Gate Posts and Guide Posts: Furnish posts for supporting single-gate leaf, or one leaf of a double-gate installation, for nominal gate widths as follows:

Leaf Width	Gate Post	lbs/lin. ft.
Up to 6'	2.875" od pipe	5.79
Over 6' to 13'	4.000" od pipe	9.11
Over 13' to 18'	6.625" od pipe	18.97
Over 18'	8.625" od pipe	28.55

- D. Top Rail: 1-inch Ø steel tubing, 1.40 lb. per ft.
- E. Bracing: Pipe brace same as top rail, with d-inch diameter steel rod truss and tightener.
- F. Tension Wire: Galvanized or aluminum-coated coil spring wire, 7 gauge.
- G. Fabric Ties: Aluminum bands or wires.
- H. Barbed-wire Supporting Arms:
  1. One for each post.
  2. Single arm at 45° with vertical, sloping to outside of fence.
  3. Constructed for attaching three rows of barbed wire to each arm and designed as a weather-tight closure cap where tubular posts are used.
  4. Designed for 300-pound minimum pull-down load.
  5. Attached to steel posts or integral with post top.
  6. Malleable iron or pressed steel.

### 2.3 ACCESSORIES

- A. Post Tops: Pressed steel, malleable iron with pressed steel extension arm, or one-piece aluminum casting; with hole for top rail, designed to fit over the outside of the posts and to prevent entry of moisture into tubular posts.
- B. Rail Couplings: Sleeve type, 6 inches long.
- C. Stretcher Bars: Steel, 1/4-inch by 3/4-inch or equivalent area.

### 2.4 GATES

- A. Manual-swing:
  1. Framing:
    - a. Fabricate perimeter frames of gates from metal and finish to match fence framework.
    - b. Provide intermediate horizontal and vertical members for proper gate operation and for attachment of fabric, hardware, and accessories. Space so that frame members are not more than 8 feet apart, unless otherwise indicated.
    - c. Frames assembled by welding or watertight galvanized steel rigid fittings.
    - d. Provide with same fabric as for fence. Install fabric with stretcher bars at vertical and top and bottom edges.
    - e. Diagonal cross-bracing of 3/8-inch diameter adjustable truss rods to ensure frame rigidity without sag or twist.
    - f. Where barbed wire is indicated or specified, extend gate-end members 1 foot above top members to receive barbed wire.

2. Hardware:
  - a. Hinges of pressed or forged steel, or malleable iron, nonlift-off type, offset to permit 180 degree gate opening, 1 ½ pair per leaf.
  - b. Latches and Gate Stops: Double-leaf.
    - i. Plunger-bar type latch, full gate height, designed to engage gate stop flush-plate type, with anchors.
    - ii. Locking device and padlock eyes an integral part of latch.
    - iii. Keeper to automatically engage gate leaf and secure free end of gate in open position.
    - iv. Provide heavy duty padlock for securing gate. Provide 3 keys to Owner. Lock shall have a plastic keyhole cover for weather protection.

## 2.5 FINISHES

- A. Steel Fencing and Gates: All steel or malleable iron parts and accessories shall be hot-dip galvanized or aluminum-coated after fabrication.
- B. Surfaces: All surfaces of aluminum which will be in contact with concrete, mortar or dissimilar metals, shall be given a heavy coat of coal tar paint.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. The installed fence shall conform to the alignment and finish grade indicated.
- B. Installed fence shall connect to existing fencing where indicated on the Drawings. Connections shall be neat and taut.
  1. Bracing shall be installed at intersections with existing fence for additional stability.
- C. All posts shall be plumb. Unless otherwise indicated on the Drawings, posts shall be spaced approximately 10 feet apart.
  1. Where posts are set in earth, concrete foundations 42 inches deep shall be provided. If bedrock is encountered, post excavation shall be continued to the 42-inch depth or 18 inches into the rock, whichever is less.
  2. Concrete foundations shall be circular in horizontal section, not less than 10 inches in diameter for line posts, and with a diameter not less than the post Ø plus 9 inches for terminal posts, except that foundations in bedrock shall be a minimum of 6 inches larger than the outside dimension of the post.
    - a. Foundations shall extend above the ground surface, and shall be crowned approximately one inch.
    - b. Concrete for foundations shall conform to Division 3.
    - c. Each foundation shall be cured for at least 72 hours before further work is done on the post.
- D. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Ground surface irregularities shall be graded, as required, to maintain not more than 2-inch clearance below the bottom of the fence fabric.
  1. Aggregate surfacing shall be placed prior to installing fabric, where applicable.
- E. Top rails and bottom tension wires shall be installed before the fabric.
  1. Top rails shall be furnished in at least 18-foot lengths, and shall be securely connected to terminal posts.

2. Tension wires shall be installed approximately 6 inches above grade, and shall be attached to each post and securely anchored at terminal posts. Straight runs between braced posts, shall not exceed 1,500 feet.
- F. A terminal post shall be provided at each change in slope.
- G. Fabric shall be attached to the top rail and bottom tension wire at 24-inch centers, and to the line posts at 15-inch centers.
- H. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties.
- I. Stretcher bars shall be provided at each terminal post, corner post, and gate post.
1. Each stretcher bar shall be threaded through the fabric and anchored to the post at 15-inch centers by positive mechanical means.
- J. Each terminal post shall be braced by a horizontal pipe brace and an adjustable truss extending to an adjacent line post.
- K. Corner posts shall be braced in both directions.
- L. Fabric shall be stretched taut and anchored, so that a pull of 150 pounds at the middle of a panel, will not lift the bottom of the fabric more than 6 inches.
- M. Manual-swing Gates:
1. Install plumb and level.
  2. Install all hardware, tracks, framing, supports, and appurtenances as required for gate type.
  3. Adjust and lubricate as necessary, for smooth operation.
  4. Install drop bar, with galvanized steel receiver pipe, minimum 12" long, set into concrete footing. Concrete footing for drop bar receiver shall be 12" diameter, 24" deep, with top crowned to shed water.
- N. Repairing Damaged Coatings:
1. Repair any damaged coatings in the shop or field by recoating with compatible and similar coating.
  2. Apply per manufacturer's recommendations.

**END OF SECTION**

## SECTION 02922

### SEEDING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Section includes: This section covers the operations necessary to establish a grass cover for stabilizing soils on new slopes and swales and in areas damaged by trenching and construction operations.
- B. Contractor shall perform all clearing, grading, fertilizing, preparing of seedbed, seeding, covering and firming of seed into the soil, application of mulch and maintenance.

##### 1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 02250 - Temporary Erosion Control

##### 1.3 SUBMITTALS

- A. The Contractor shall submit the following items, in accordance with Section 1300 - Submittals:
  - 1. Product data for review:
    - a) Representative labels bearing the composition of seed mixtures.
  - 2. Product data for information:
    - a) Copies of suppliers' invoices for all seed, mulch and fertilizer showing the weight purchased for the project.
  - 3. Manufacturer's certifications for review:
    - a) Manufacturer's certifications stating purity and components of seed bags and mixtures.

##### 1.4 GUARANTEE

- A. The Contractor shall unconditionally guarantee a stand of grass that is reasonably uniform in density and reasonably free of weeds and otherwise acceptable to the Owner.

#### PART 2 PRODUCTS

##### 2.1 SEED

- A. Seed: All seed shall be labeled in accordance with U.S. Department of Agriculture Federal Seed Act. Seeds shall be free of prohibited weed seeds and shall contain no more than one percent of noxious weed seeds.
  - 1. Seeds shall be delivered to the site in convenient, fully labeled containers bearing the name, trade name or trademark and warranty of the manufacturer with a certificate of the purity and germination of each kind of seed.
  - 2. Type "A" seed mixture shall be used for established yards, shoulders and slopes in street right-of-way, at WWTP sites, and any other areas designated on the drawings. Type "A" seed mixture shall be as follows:

<u>Type of Seeds</u>	<u>Minimum Pure Live Seed (%)</u>	<u>Rate of Pure Live Seed (Lbs. per Acre)</u>
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior Var. Arundinces)	75	25
Rye Grass (Lolium Perenne or L. Multiflorum)	80	25
Kentucky Blue Grass (Poa. Pratensis)	75	20
Creeping Red Fescue (Festuca Rubra)	85	10
Total		80 lb/acre

3. Type “B” seed mixture shall be used for areas outside of the street right-of-way which are not maintained and any other areas designated on the drawings. Type “B” seed mixture shall be as follows:

<u>Type of Seeds</u>	<u>Minimum Pure Live Seed (%)</u>	<u>Rate of Pure Live Seed (Lbs. per Acre)</u>
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior)	75	90
Rye Grass (Lolium Perenne or L. Multiflorum)	80	50
Total		140 lb/acre

- 2.2 FERTILIZER: Fertilizer shall be a complete commercial grade fertilizer applied at the rate of 87 pounds of plant available nitrogen per acre.
- 2.3 MULCH: Mulch shall be hay or straw with no viable seeds of noxious weeds. Mulch shall be spread uniformly over the seeded areas at the rate of 100 pounds per 1000 square feet and anchored into the soil a minimum of 3 inches to provide a standing stubble mulch.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Clearing and stripping, earthwork, grading, and placement of topsoil shall be performed per specifications.

#### **3.2 SEEDING**

- A. Seeding: Seeding shall be performed on all areas disturbed by construction that are not reestablished by sodding, pavement, gravel, driveways and other methods of reestablishment. Included shall be seeding, fertilizing, mulching, preparation of seed beds, and maintenance. The Contractor shall reseed any seeded areas that are not in good growing condition following the first full growing season (spring to fall).

1. Fertilizer shall be evenly distributed before tilling, at a rate of six hundred (600) pounds per acre (7 pounds per 500 square feet ) and incorporated into the soil to a depth of at least two inches by disking or harrowing.
2. Those areas designated to be seeded shall be cleared and graded prior to tilling. The surface shall be tilled to a depth of at least two inches by disking or other approved methods until the surface is suitable for seeding. The prepared surface shall be maintained until seeding and mulching is completed to prevent gullies and depressions.
3. All seeding work shall be done between February 1 and April 15 or between August 15 and October 15. The specified seed shall be sowed using a mechanical spreader or drill at the application rate. Successive seeding strips shall be overlapped to provide uniform coverage.
4. Seed that is wet, moldy or otherwise damaged in transit or storage shall not be used. Seeding shall not take place when wind velocity exceeds five (5) miles per hour.
5. Immediately following completion of seeding, if in the Engineer's judgment the seed bed is too loose or contains clods, the entire area shall be compacted using a roller weighing at least sixty (60) but not more than ninety (90) pounds per lineal foot of roller.
6. Within 24 hours of seeding, vegetative mulch shall be spread over all seeded areas. Mulch shall be spread uniformly with a mechanical spreader or other approved methods at a rate of two (2) tons per acre. Mulch shall be spread in a loosened condition with no lumps of compacted material. Mulch shall be anchored using a heavy disc harrow by no more than two passes of the harrow. Discs of the anchoring tool shall be set approximately nine inches apart. Mulch shall be anchored not cut.
7. Seeded areas shall be watered immediately following application of mulch to a depth of at least two (2) inches. Care shall be taken not to cause erosion or displacement of seed. Watering shall be repeated daily until a flourishing grass coverage is achieved. The seeded area shall be kept free of traffic. Any portion gullied, damaged or destroyed shall be repaired or re-established to the specified conditions at the Contractor's expense prior to acceptance by the Owner.
8. Maintenance: Maintenance shall include watering, as required, of the seed bed and resulting growth and replacement of any areas eroded by any causes.

**END OF SECTION**

## SECTION 03300

### MISCELLANEOUS CONCRETE

#### PART 1 GENERAL

##### 1.1 GENERAL

- A. The Contractor shall provide all concrete work as required to complete the concrete construction as specified herein and as shown on the Drawings.

##### 1.2 RELATED SECTIONS

- A. Section 01300 - Submittals
- B. Section 02732 - Sanitary Sewer System

##### 1.3 REFERENCES

The following publications form a part of these specifications to the extent indicated by references thereto. Only the most recent revisions of these publications shall be used.

- A. ASTM A - 615 Deformed And Plain Billet Steel Bars For Concrete Reinforcement
- B. ASTM C - 31 Test Methods of Making and Curing Concrete Test Specimens in the Field
- C. ASTM C - 33 Concrete Aggregates
- D. ASTM C - 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens
- E. ASTM C - 94 Ready-Mixed Concrete
- F. ASTM C - 143 Slump Of Portland Cement Concrete
- G. ASTM C - 150 Portland Cement
- H. ASTM C - 185 Test Method for Air Content of Hydraulic Cement Mortar
- I. ACI 304 Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
- J. ACI 305 Committee Report on Hot-Weather Concreting
- K. ACI 306 Committee Report on Cold-Weather Concreting
- L. ACI 309 Recommended Practice for Consolidation of Concrete
- M. ACI 318 Building Code Requirements For Reinforced Concrete
- N. ACI 347 Recommended Practice for Concrete Formwork

1.4 SUBMITTALS

- A. Contractor shall submit product data for review on the following items required by this Division:
  - 1. Laboratory name.
  - 2. Aggregate testing and gradation.
  - 3. Design mix.
- B. Product data shall be submitted in accordance with Section 1300 - Submittals.

PART 2 PRODUCTS

- 2.1. CEMENT: Cement shall conform to ASTM C150, Type I. Cement may be bagged or bulk. Cement shall be used from only one mill throughout the entire project.
- 2.2. FINE AGGREGATE: Fine aggregate shall conform to ASTM C33 and have the following gradation:

<u>Sieve</u>	<u>% Passing</u>	<u>% Retained</u>
3/8"	100	0
#4	95-100	0-5
#8	80-100	0-20
#16	50-85	15-50
#30	25-60	40-75
#50	10-30	70-90
#100	2-10	90-98

2.3. COARSE AGGREGATE

- A. Coarse aggregate shall conform to ASTM C33 and have the following gradation:

<u>Sq. Sieve</u>	<u>% Passing</u>	<u>% Retained</u>
3/4"	90-100	0-10
3/8"	20-55	45-80
#4	0-10	90-100
#8	0-5	95-100

## 2.4. WATER

- A. Treated and filtered water from a municipal or other public water supply district shall be used.

## 2.5. REINFORCING STEEL

- A. All bars shall conform to ASTM A615, Grade 60. Bending details shall conform to ACI 318.

## 2.6. FORMS

- A. The forms shall be true and rigid and conform to shape, line and dimensions as shown on the Drawings. All forms shall be rigidly constructed, braced and tied to prevent any deflection or displacement during placing of concrete. All exposed corners and edges shall have 1" fillets. All joints shall be mortar tight; open joints shall be sealed as required.

## 2.7 CONCRETE MIX

- A. Proportioning: Concrete shall conform to the following:
  - 1. Cement: 6 sacks per cubic yard, minimum.
  - 2. Water: Water shall be kept to an absolute minimum to maintain slump as specified.
  - 3. Aggregate: The sand factor shall be as required to give the best workable mix within the range of 46 to 52 percent of total aggregate by weight.
  - 4. Strength: Minimum 4000 psi at 28 days.
- B. Slump: The maximum slump shall not exceed 4 inches. Determination of slump shall conform to ASTM C143.
- C. Mixing: Contractor shall use ready-mixed concrete, mixed and delivered in conformance with ASTM C94.
- D. Admixtures: Air entraining agents shall be added to the concrete to provide 4 to 6 percent entrained air when placed, in conformance with ASTM C185.

## PART 3 EXECUTION

### 3.1 PLACING REINFORCING STEEL

- A. All bars are to be accurately placed and securely tied at all intersections.
- B. Reinforcing steel shall be free from flaky or scaly rust which will destroy or reduce the bond strength at the time concrete is placed.
- C. Unless shown otherwise on the Drawings, the following minimum concrete coverage shall be maintained:
  - 1. Against earth: 3"
  - 2. Against forms or when exposed to water or weather: 2"

### 3.2 PLACING CONCRETE

- A. No concrete shall be deposited below water. The excavation may be damp but shall contain no free water.
- B. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials. Retempering of concrete is not permissible.

- C. All concrete shall be thoroughly compacted during placement by means of vibrators in conformance with ACI 309.
- D. For formed surfaces, the Contractor shall break off ties, grout voids which are deeper than 1/2" and chip out honeycombed areas to solid concrete and grout flush with formed surface.
- E. Curing shall be maintained continuously for seven days after placing concrete or until forms are removed and the surface finished. Concrete surface temperature is to be maintained between 50° and 100° for at least seven days.
- F. Concrete shall not be placed on iced or frozen subgrade or when the air temperature is below 20°. Concreting shall not be continued when the air temperature is below 45° unless the following conditions are attained:
  - 1. Mixing water shall be heated (to a maximum of 150°).
  - 2. Aggregates shall be heated until free of all ice and frost.
  - 3. The concrete temperature after mixing shall be between 50° and 70° if the air temperature is 20° to 45°.
  - 4. After the concrete is placed, it shall be covered, protected, and heated so as to maintain a minimum of 70° air temperature for the first 24 hours and 50° air temperature for the next six days. Open-flame type heaters are not permitted. Heating equipment not vented outside of the covering will not be permitted.
  - 5. Moist conditions shall be maintained during the heating period.
  - 6. All covering, heating equipment, etc., shall be on hand and approved by the Engineer before any concrete is placed.
- G. Admixtures, such as calcium chloride, shall not be used.
- H. Exposed concrete is not to be placed in air temperatures above 100°. Cover, protect and cool work as required to maintain the temperature of the concrete below 100°. The concrete temperature, after mixing, shall not be greater than 85°. Spray and/or shade aggregate piles and cool mixing water as required.

### 3.3 CONCRETE TEST CYLINDERS

- A. Not required for this project.

**END OF SECTION**

## SECTION 11307

### SUBMERSIBLE GRINDER PUMP STATION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General: This Section includes equipment, material, and service requirements for furnishing and installing grinder pumps and accessories. The principal items shall include, but not be limited to, the following: submersible centrifugal grinder pumps; guide rails; wetwell access hatch; discharge seals, pump discharge and anchoring elbows, valves, bolts including anchor bolts, nuts and gaskets, controls, etc.
- B. Single Source: The pumping equipment and controls shall be the product of a single supplier.

##### 1.2 RELATED SECTIONS

- A. Section 02732 - Sanitary Sewer System
- B. Section 03300 - Miscellaneous Concrete.
- C. Division 16 - Electrical
- D. Section 16905 - Lift Station Controls and Instrumentation: For controls and panels.

##### 1.3 REFERENCES

- A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:
  - 1. Standards of the Hydraulic Institute.
  - 2. NEC, National Electric Code.
  - 3. NEMA, Standards of National Electric Manufacturers Association.
  - 4. IEEE, Institute of Electrical and Electronic Engineers.
  - 5. AFBMA, Anti-Friction Bearing Manufacturers Association.
  - 6. ANSI, American National Standards Institute.
  - 7. SSPC, Steel Structure Painting Council
  - 8. ASTM, American Society for Testing and Materials.
  - 9. AISI, American Iron and Steel Institute.

##### 1.4 DEFINITIONS

- A. NPSH - Net Positive Suction Head.
- B. NPSHR - Net Positive Suction Head Required.

##### 1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 01300-Submittals.
- B. Submit locations of the nearest permanent service headquarters of the pump and motor manufacturers.

- C. Submit descriptive literature, including a cross-sectional view of each pump and motor combination, which indicates materials of construction, weights, principal dimensions and other important details.
- D. Submit characteristic curves showing the head-capacity relationship, brake horsepower, NPSH requirements, pump efficiency (ratio of the water horsepower to brake horsepower) and pump speed. The curves shall be complete for the entire range of operation from shutoff to minimum head conditions.
- E. Submit operation and maintenance data under provisions of Section 01300-Submittals and Section 01700 - Contract Closeout..
- F. Record Drawings: Submit record drawing under provisions of Section 01700-Contract Closeout.
- G. Submit copy of pump warranty.

#### 1.6 QUALITY ASSURANCE

- A. All materials used shall be new, of high grade and of properties best suited to the Work required.
- B. Manufacturer's Qualifications:
  - 1. Pumping equipment provided under this Section shall be standard product in regular production by manufacturers whose products have proven reliable in similar service for at least five (5) years.
  - 2. Manufacturer shall satisfy the Engineer that they are capable of the following:
    - a. Providing local factory trained personnel to service the pumps and allied equipment when needed within 24 hour period.
    - b. Providing needed spare parts for the pumps within 48 hour period.
- C. Coordination Responsibility:
  - 1. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver equipment to site under provisions of Section 01600 - Material and Equipment.
- B. Store and protect equipment under provisions of Section 01600 - Material and Equipment.
- C. Store all equipment off the ground in enclosed shelter.

#### 1.8 WARRANTY

- A. Provide warranty under provisions of Section 01700 - Contract Closeout.
- B. Pump manufacturer shall furnish to the Owner a written warranty against defects in workmanship and materials for two (2) years or 10,000 hours of operation, whichever is less, under normal use and service. All parts shall be covered under warranty, and controls shall be included. Coverage shall be full and not prorated. Pumps shall be picked up by manufacturer's representative or shipping covered under warranty. Pumps shall be repaired under warranty and shall be returned to Owner freight-pre-paid. Warranty shall be in printed form.

- C. Service Calls:
1. Pump manufacturer or his authorized representative may visit the installation as he sees fit to troubleshoot and inspect the pumps during the warranty period. Manufacturer's service personnel shall contact the Owner at least one working day prior to such visits.
  2. When Owner has notified the manufacturer of a problem, manufacturer shall respond promptly. If a pump is out of service or if the controls system is experiencing problems, manufacturer shall arrive to service the installation not more than 48 hours after notification by Owner. A factory trained and authorized technician shall be available to address problems with the pumps and controls.
  3. Manufacturer may elect to try and direct Owner's personnel to correct the problem, if the problem is simple and Owner is able to assist. If unsuccessful, such efforts shall not eliminate manufacturer's responsibility to make a service call.
  4. Manufacturer shall maintain a log of all service performed on the equipment during the warranty period, and shall furnish Owner a copy of this log upon request, and at the end of the warranty period.
  5. Manufacturer shall provide Owner with necessary forms to accurately keep records of maintenance.
- D. Responsibilities of Owner: Owner will be responsible for the following activities:
1. Change the oil in the reservoir at manufacturer's recommended interval, but such interval shall not be required by the warranty to be less than 12 months.
  2. Maintain the pumping units in good working order, including clearing pump blockages.
  3. Allow the pumps to be alternated or exercised regularly to distribute wear and prevent prolonged periods of inactivity.
  4. Perform routine troubleshooting and run diagnostics, as outlined in the Operation and Maintenance Instructions.
  5. When a problem occurs, perform initial troubleshooting and assessment of situation, eliminating the problem if possible. Contact the manufacturer if expertise or service is required.
  6. Owner shall maintain a log of all maintenance performed on the equipment during the warranty period, and shall furnish the manufacturer a copy of this log upon request.
- E. Effective Date: The warranty shall become effective upon Substantial Completion of the Work, or the date which the last of the pumps is started, if it occurs first. Warranty shall not commence on the date of delivery nor of shipment.

1.9 MANUFACTURER'S FIELD SERVICES: In accordance with Section 01650 - Starting of Systems, an authorized representative of the manufacturer shall provide the following:

- A. Start-up Services: As required, with a minimum of two 6-hour sessions, of which at least 3 hours shall be dedicated to demonstration and training. In addition to the requirements of Section 01650, demonstration and training shall cover the following:
1. Controls function and sequence of operation.
  2. Maintenance procedures, including use of megohm meter and how to interpret results.
  3. Proper removal and installation of submersible pumps.
- B. Provide services for end-of-warranty-period inspection.
- C. Provide additional services to repair or correct any deficiencies noted at start-up or warranty inspection.

- D. On-site Testing: As specified herein.

## **PART 2 PRODUCTS**

### 2.1 GENERAL

- A. Pumps shall be designed for continuous operation without cavitation within the specified pump range as shown on the Drawings. Pumps shall be designed to operate up to one hour in air without damage. The pump shall have as high efficiency as possible at the rated capacity. The NPSHR at the maximum operating capacity shall not exceed 28 feet. All seals shall be solvent resistant.
- B. Grinder pumps shall contain special cutters to reduce sewage to a fine slurry, using stationary and rotary cutters.

### 2.2 MANUFACTURER:

- A. Base Bid Manufacturers: Contractor shall base his bid on products by the following:
  - 1. ITT - Flygt Corporation, MP-3068 with 218 impeller.
- B. Equivalent products of other manufacturers may be proposed to the Engineer. The burden rests on the Contractor and Supplier to prove to the Engineer that the proposed substitute meets the letter of the specifications. Engineer shall have sole authority in deciding if proposed product does or does not meet the specifications. Because Contractor has based his Bid on the named Base Bid Manufacturer, Contractor shall have no justifiable claim for additional compensation or Contract Time if Engineer does not accept the substitute.

### 2.3 DESIGN REQUIREMENTS:

- A. Requirements:
  - 1. Furnish and install 2 submersible wastewater grinder pump(s). Each pump shall be equipped with a 4 HP, submersible electric motor connected for operation on 208 volts, 3 phase, 60 hertz, 4 wire service, with 25 feet of submersible cable (SUBCAB) suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards and also meet with P-MSHA Approval. The pump shall be supplied with a mating cast iron 2 inch discharge connection and be capable of delivering 25 GPM at 69 feet TDH. Shut off head shall be 81 feet (minimum). Each pump shall be fitted with 15 feet of lifting chain or stainless steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.
- B. Grinder pump(s) shall be available in the following configuration:
  - 1. MP - Guide Bar Mounting - 2" Discharge.
  - 2. The MP Grinder pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. **Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.** No portion of the pump shall bear directly on the sump floor.
- C. Each grinder pump shall be a heavy duty pump modified to be used as a grinder. Each grinder pump shall contain special cutters to reduce sewage to a fine slurry. The stationary cutter shall consist of hardened 316 "L" stainless steel and the rotary cutter shall consist of chrome alloyed

cast iron. The cutter materials shall provide maximum corrosion and abrasion resistance. The remaining portion of the grinder pumps, with the exception of seal materials and wet end, shall be similar to the heavy duty pumps used in larger pump stations for daily operation.

## 2.4 WETWELL AND VALVE VAULT

- A. The wetwells and valve vaults shall be as shown on the Drawings.

## 2.5 PUMP CONSTRUCTION

### A. Casing:

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. All exposed nuts or bolts shall be AISI type 316 stainless steel or brass construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
2. Sealing design shall incorporate **metal-to-metal** contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or optional Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
3. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.
4. Motors are sufficiently cooled by the surrounding environment or pumped media. A water jacket is not required.

### B. Cable Entry:

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. **The assembly shall provide ease of changing the cable when necessary using the same entry seal. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable.**
2. Cable shall be capable of operating under continuous submergence without loss of watertight integrity to a depth of 50 feet.

### C. Submersible Motor

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no

less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The motor and pump shall be designed and manufactured by the same source.

2. The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.
3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

D. Bearings:

1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. **Sleeve or single row lower bearings are not acceptable.**

E. Mechanical Seal:

1. Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in an lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion-resistant **tungsten-carbide** ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary **ceramic** seal ring and one positively driven rotating **carbon** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.
2. **The following seal types shall not be considered acceptable nor equal to the dual independent seal specified:** shaft seals without positively driven rotating members, or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces. No system requiring a pressure differential to offset pressure and to effect sealing shall be used.
3. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. **The motor shall be able to operate dry without damage while pumping under load.**

**Seal lubricant shall be FDA Approved, nontoxic.**

F. Pump Shaft:

1. Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T.
2. If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T is used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

G. Impeller:

1. The impeller(s) shall be of gray cast iron, Class 35B, dynamically balanced, single shrouded design having a long throughlet without acute turns. The impellers shall be capable of handling fine slurry from the special cutters. Impeller(s) shall be taper collet fitted and retained with an Allen head bolt. All impellers shall be coated with an acrylic dispersion zinc phosphate primer.

H. Volute:

1. Pump volute(s) shall be single-piece grey cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any media that may enter the impeller. Minimum inlet and discharge size shall be as specified.

I. Protection:

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. At 125°C (260°F) the thermal switches shall open, stop the motor and activate an alarm.
2. A leakage sensor shall be available as an option to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will send an alarm and, if desired, stop the motor. **USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.**
3. The thermal switches and FLS shall be connected to a Mini CAS (Control and Status) monitoring unit. The Mini CAS is designed to be mounted in any control panel.

## 2.6 ACCESSORIES FOR WETWELL MOUNTED PUMPS

A. Pump Discharge Connection: Pump discharge connection elbow and discharge piping shall be installed such that pump will automatically connect and seal to discharge connection elbow when lowered into place.

1. Both pumps shall be fitted with at FLYGT (or approved equal) mix flush valve. The valve will be fitted to a heavy cast mounting face ‘boss’, on one side of the pump volute. The valve shall, upon initial pump operation, induce a powerful stream of wastewater throughout the wetwell thereby resuspending and breaking up and built up sludge, grease or sediment. The valve shall have an adjustable closing period of 20-50 seconds and operate solely by mechanical means making it suitable for use in hazardous locations Class 1, Division 1 or 2, Groups C and D.
2. Base elbow connected to discharge piping and anchored to sump floor with stainless steel anchor bolts. Pump supplier shall provide 304L or 316 stainless steel threaded rod anchors ¾” minimum diameter, 5” minimum embedment for anchorage of base elbow. Epoxy grout into concrete slab.

3. Note: Base shall consist of elbow integrally cast with mounting base. Base which requires attachment of a separate elbow will not be acceptable. Base shall have holes sized to accept 3/4" diameter anchor bolts.
  4. Designed to receive pump discharge connection without bolts.
  5. Designed to receive guide rail(s).
  6. Cast or ductile iron.
  7. Flanges shall conform to ANSI B16.1.
  8. Seal interface of the pump and discharge elbow by non-sparking metal-to metal contact, or by metal to rubber contact with the use of a profile gasket mechanically held in place between the pump and the sliding guide bracket.
- B. Pump Lifting: Provide grab-link system, with short length of stainless steel chain, nylon cord, and link attachment device.
- C. Guide Rails:
1. Stainless-steel pipe, Schedule 40 minimum.
  2. All 316 or 304L stainless steel, including rails, brackets, and anchor bolts.
  3. Size as recommended by pump manufacturer, 1-1/2-inch minimum dia.
  4. Shall not support any portion of the pump weight.
  5. Provide stainless steel guide rail supports bolted to wetwell walls, at maximum of 15 foot intervals along rails. Not required when length of guide rails is less than 15 feet.
  6. Provide upper guide rail bracket, cast iron or stainless steel.
- D. Power and Control Cable Holder: (Provide for tank or wetwell mounted pumps.):
1. 304L stainless steel, with mounting bracket.
  2. Provide grip holders for pump and control cables.
  3. Cables shall be easily adjusted to pumping level without splices.
  4. Provide power and control cables which are sealed at the motor and continuous from the motor to the panel or intermediate waterproof junction box for removing submersible pump for maintenance.
  5. Provide stainless steel Kellems grips for power cords.
- E. Access Hatches:
1. Acceptable Manufacturers: Access hatches shall be of the size as required by pump manufacturer and shall be manufactured by the following or equal:
    - a. Bilco Company
    - b. Halliday Products
  2. Description:
    - a. Access hatches in exterior locations shall be floor door type, designed to withstand a live load of 300 pounds per square foot.
    - b. Door leaves shall be 1/4 inch thick aluminum diamond pattern plate.
    - c. Frame: Angle Frame.
    - d. Hatches shall open to 90 degrees. Devices shall be provided for easy operation, including an automatic hold open arm with release handle for each door leaf. A snap lock with removable handle shall be provided for each hatch.
    - e. Finish: Hatches shall be mill finished. All surfaces of aluminum which will be in contact with concrete or mortar when installed shall be given a heavy coat of coal tar or bituminous paint.
- F. Other Accessories: Provide other accessories indicated on the Drawings.

## 2.7 PIPING AND VALVES

- A. Pump Discharge Piping In Wetwell: As indicated on the Drawings.
- B. PVC Ball Valves: PVC ball valves shall be provided where indicated on the Drawings.
  - 1. PVC ball valves shall be full-size port, true-union design with two-way blocking capability, rated for 150 psi at 70°F. Valves shall have PVC bodies, Viton or EPDM O-rings, and Teflon seats. Valves shall be provided with operating levers. Where noted on the Drawings, valves shall be provided with operating nuts, stem extensions with operating handle, and wall supports. The stem extensions and supports shall be a kit supplied by the valve manufacturer and designed to work with the valve used. PVC ball valves shall be Asahi/America “Duo-Bloc”, Hayward “Safe Block”, or equal.
- C. Bronze Flapper Check Valves: Bronze flapper check valves shall be provided where indicated on the Drawings.
  - 1. Bronze flapper swing check valves shall be class 125 and shall comply with MSS-SP-80 type 3. Valves shall have bronze bodies, caps, discs and hinges, brass hinge pins and side plugs and stainless steel retaining rings. Ends shall be threaded. Bronze flapper swing check valves shall be as manufactured by Watts, or equal.

## 2.8 SHOP PAINTING

- A. All surfaces, other than stainless steel, coming into contact with the liquid media shall be protected by a shop-applied epoxy paint system, suitable for operation in sewage.
- B. Machine finished surfaces:
  - 1. Clean machined parts are to remove all dirt and grease.
  - 2. Clean so as not to affect primer or deteriorate adherence to finish paint.
  - 3. Store and transport in such a way that rust-attach on machined surfaces does not occur.
  - 4. At assembly, coated surfaces are with a corrosion preventive coating.

## 2.9 PUMP PROTECTION SYSTEM: Furnished by pump manufacturer.

- A. Furnish a complete pump monitoring and protection system consisting of a intrinsically safe solid state monitoring module to be installed in the motor starter cubicle and independent probes integral to the pump/motor, as specified herein, wired to a sealed cable entry terminal box for connection of submersible control cables.
- B. Monitoring unit (or multiple such) shall be a solid-state module designed for mounting within the motor starter cubicle or as indicated on the Drawings. Monitoring unit shall employ conventional logic and noise isolated electronics. Monitoring unit shall accept inputs from the sensors (seal leakage, motor over temperature, motor auto-megger) specified and shall output independent contacts which close to alarm each condition, or separate independent output terminals suitable for direct connection to interposing relays for alarm contact development. Provide a separate N.C. alarm contact, rated at 120V, 5A inductive, which opens on any failure. The monitoring unit shall accept separate isolated N.O. contacts which close to indicate pump running and to reset after pump trip.

## 2.10 ELECTRICAL EQUIPMENT AND CONTROLS

- A. Conform to NEC, NEMA, IEEE and DIVISION 16 on all electrical equipment and controls.

- B. Refer to DIVISION 16 for electrical control panel, motor starters, and pump controls.

### **PART 3 EXECUTION**

3.1 **INSTALLATION:** All Work shall conform to the Drawings, the manufacturer's recommendations, and the requirements of DIVISION 1.

- A. Install wetwell cover and access hatch.
- B. Attach base elbows, guide rails, and make piping connections.
- C. Make all electrical and control connections, in accordance with DIVISION 16.
- D. Provide a complete unit with all materials, components and adjustments as required for successful operation.

3.2 **START-UP AND TESTING:**

- A. Provide all necessary lubrication for initial start-up, testing and as required for final acceptance.
- B. Installation, start-up and testing of all equipment and associated construction shall conform to manufacturer's recommendations.

3.2 **ON-SITE PERFORMANCE TESTS:**

- A. Conducted by pump manufacturer's authorized representative in presence of Contractor and Engineer.
- B. Equipment Tests:
  - 1. Check performance of all components as a functioning unit.
  - 2. Check alignment of each unit.
  - 3. Confirm proper rotation of impeller.
- C. Operational Tests:
  - 1. Conduct such operational tests as necessary to determine that the performance of equipment and controls is as specified.
  - 2. Tests will generally consist of placing equipment in operation under varying conditions and verifying performance.
    - a. Test all control sequences and functions.
    - b. Perform complete megger testing.
    - c. Take amperage and voltage readings.
  - 3. Dry Run Test: No liquid is to be allowed to enter the inlet of the pump. The exterior of the pump shall be dry and remain dry during test. Test duration shall be a minimum of 30 minutes.
- D. Capacity Test: On three occasions, wet well shall be filled with liquid to an elevation sufficient to allow each single pump to operate for three minutes, independent of the control regime. Time required to pump down known volume shall be measured as evidence of each pump's capacity. All portions of the force main must have been constructed and tested prior to this test.
- E. Make all necessary equipment adjustments and corrective work indicated by tests. Repeat testing as necessary.

- F. Submit a written test report to General Contractor (with one copy to Engineer) in a letter form stating operations performed and results obtained for each unit.

**END OF SECTION**

## SECTION 14600

### HOISTS AND CRANES

#### PART 1 GENERAL

- 1.1 GENERAL: Equipment and accessories provided under this section shall be fabricated, assembled, erected and placed in proper operating condition in full conformity with Drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer.
- 1.2 SECTION INCLUDES
- A. Portable Davit Crane and Accessories
- 1.3 REFERENCES: Equipment provided under this section shall comply with the applicable requirements of the following. The revision in effect at the time of the bid opening shall be applicable.
- A. Occupational Safety and Health Standards of the U. S. Department of Labor; Subpart N, Materials Handling and Storage
- B. Monorail Manufacturer's Association (MMA) "Specifications for Underhung Cranes and Monorail Systems".
- C. ANSI/ASME HST-2M, "Performance Standard for Hand Chain Manually Operated Chain Hoists".
- D. ANSI/ASME B30.10, "Hooks".
- E. ANSI/ASME B30.11, "Monorails and Underhung Cranes".
- F. ANSI/ASME B30.16, "Overhead Hoists (Underhung)".
- G. ANSI MH27.1, "Specifications for Underhung Cranes and Monorail Systems".
- 1.4 SUBMITTALS: The following items shall be submitted as required by this Division, in accordance with Section 01300 - Submittals, and Section 01700 - Contract Closeout:
- A. Product Data for Review: Complete outline and assembly Drawings, together with detailed specifications and data covering materials used, parts, devices and other accessories forming a part of the equipment furnished, shall be submitted for all equipment provided in this Section, in accordance with Section 01300 - Submittals.
- B. Operation and Maintenance Data: Approved Operation and Maintenance Instructions shall be provided in accordance with Section 01700 - Contract Closeout.
- 1.5 PERFORMANCE AND DESIGN REQUIREMENTS
- A. Performance Requirements: Davit crane and hoist will be used to assist in servicing submersible pumps at lift stations. The equipment supplied shall be suitable for use and operation in an exterior location.
- B. General Design Requirements: Loading, impact allowances and allowable stresses shall be in accordance with the governing standards.

## **PART 2        PRODUCTS**

- 2.1    DAVIT CRANE: Provide one davit crane, shared between the lift stations. Install a crane base at each station.
- A.     Manufacturer
1.       Davit Crane shall be as manufactured by Thern, Inc. "Model 5123M1GAL" or equal.
- B.     Components
1.       Winch shall be equipped with bronze bearings for smooth and efficient operation.
  2.       Wire rope anchor shall be secured to an anchor hole in the flange of the drum, allowing rapid attachment or removal of wire rope from the crane, so that wire rope assemblies can be left permanently attached to submersed pumps and mixers while the crane is moved to a new location.
  3.       Boom and mast rotate 360 degrees under load, in a bearing sleeve in the base. A pivoting handle shall be provided.
  4.       Boom shall be adjustable to three different positions for operation, and shall fold down for storage or transport.
  5.       Loads shall be lifted with a stainless steel spur gear hand winch contained within the boom. The winch shall be equipped with an automatic disc brake for load control, and gear covers to protect gears and help prevent injuries. Winch components shall have zinc and iridescent dichromate plated finish for corrosion resistance.
  6.       Lifting Capacity: 1,000 pounds.
- C.     Accessories
1.       One (1) Thern, Inc. "Model 523" pedestal base, or equal.
  2.       One (1) stainless steel 1/4" diameter wire rope, with stainless eye hook and swagged ball fitting, with minimum length of 28 feet.
  3.       Galvanized steel expansion anchor bolts for anchoring base, 5/8" minimum diameter.
- D.     Finishes
1.       Crane and bases shall have a galvanized finish for superior corrosion protection.

## **PART 3        EXECUTION**

- 3.1    INSTALLATION: All work shall conform to manufacturer's recommendations and the requirements of Division 1.

**END OF SECTION**

## SECTION 16050

### BASIC ELECTRICAL MATERIALS AND METHODS

#### PART 1 GENERAL

- 1.1 SUMMARY: Provide complete distribution systems for electrical power and lighting as shown on the Drawings or required by other sections of these specifications.
- A. Work includes, but is not necessarily limited to:
1. Distribution system for power, including connection to existing panel, branch-circuit bolt-on type breakers, and any required metering equipment not provided by the electrical utility. Power system shall be 208/120 volt (V), 60 Hertz (Hz), 3-phase, 4-wire.
  2. Installation of control panel, motor starters, combination starters, safety switches, manual transfer switch, and controls, whether provided under this section or other sections of these specifications.
  3. Grounding system.
  4. Other items and services required to complete the electrical systems.
- 1.2 APPLICABLE PUBLICATIONS: Industry publications controlling the work of this Section include:
- A. American Society for Testing and Materials (ASTM):  
ASTM B8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- B. National Electrical Manufacturer's Association (NEMA):  
NEMA FU 1: Low Voltage Cartridge Fuses.  
NEMA ICS: Motor Starters.
- C. National Fire Protection Association (NFPA):  
NFPA 70: National Electrical Code (NEC).  
NFPA 78: Lightning Protection Code.  
NFPA 101: Life Safety Code.  
NFPA 110: Emergency and Standby Power Systems.
- D. Occupational Safety and Health Administration (OSHA):  
Occupational Safety and Health Standards.
- E. Underwriters Laboratories Inc. (UL):  
UL 57: Electric Lighting Fixtures.  
UL 96: Lightning Protection Components.  
UL 96A: Installation Requirements for Lightning Protection Systems.  
UL 98: Enclosed and Dead-Front Switches.  
UL 198E: Class R Fuses.  
UL 498: Attachment Plugs and Receptacles.  
UL 943: Ground-Fault Circuit Interrupters.  
UL 1449: Standard for Safety, Transient Voltage Surge Suppressors, Revised Edition, July 1987.
- 1.3 SUBMITTALS: Submit the following in accordance with Division 1. Submittals are for the record or approval, as indicated.
- A. Catalog cuts of safety switches for approval. Provide time-current characteristic curves for all fuses supplied.

- B. Catalog cuts of grounding conductor, ground rods and connectors for the record.
  - C. Catalog cuts of power and control cable and connectors for the record.
  - D. Upon completion of this portion of the work, and as a condition of its acceptance, submit operation and maintenance manuals. Include within each manual:
  - E. Copy of the Record Documents for this portion of the work.
  - F. Copies of all circuit directories.
  - G. Copies of all warranties and guarantees.
  - H. Emergency instructions.
  - I. Spare parts list.
  - J. Wiring diagrams.
  - K. Shop drawings and product data.
    - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
    - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
    - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - L. Include the following information for equipment items:
- 1.4 COORDINATION: Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- A. Coordinate replacement of disconnect panel with on-site MoDOT staff for any required downtime of power supply to the rest area.
  - B. Coordinate the installation of the new disconnect panel with AMERENUE. Contact information is noted on the plans.

**PART 2 PRODUCTS**

2.1 MATERIALS AND EQUIPMENT

- A. Provide only materials that are new, of the type and quality specified, and free from defects and imperfections. Where Underwriters Laboratories Inc. has established standards for such materials, provide only materials bearing the UL label.
- B. Manufacturers that can provide products meeting these specifications have been identified. Other manufacturers' products meeting these specifications may be acceptable subject to submittal of certificate of compliance, review, and approval. Where catalog numbers are shown, they should be

verified with the manufacturer to assure continued accuracy and compliance with these specifications.

- C. All materials and equipment of the same type shall be made by the same manufacturer.
- D. All materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.

## 2.2 DISTRIBUTION

### A. Conduit, Fittings

- 1. Rigid Galvanized Steel Conduit (RGS)
  - a. Each length threaded on both ends.
  - b. All scale, grease, dirt, burrs, and other foreign matter removed from inside and outside prior to application of coating materials.
  - c. Galvanized by the hot-dip process as follows:
    - 1) Interior and exterior surfaces coated with a solid, unbroken layer of 99% virgin zinc by dipping.
    - 2) One coat of zinc chromate finish on inside and outside surfaces to prevent oxidation and white rust.
  - d. Couplings and elbows fabricated, coated, and finished by the same process as conduit.
  - e. Where conduits enter boxes or cabinets without threaded hubs, double locknuts shall be used plus a phenolic insulated metallic bushing on the open end.
- 2. Rigid Polyvinyl Chloride (PVC) Conduit
  - a. Fabricated from self-extinguishing, high-impact, polyvinyl chloride designed for above ground and underground installations.
  - b. Type EPC, Schedule 40, heavy-wall rigid conduit, Schedule 80 where noted on the Drawings, unless noted otherwise.
  - c. Fittings and accessories fabricated from same material as conduit.
  - d. Solvent-cement-type joints as recommended by manufacturer.
- 3. Flexible Liquidtight Nonmetallic Conduit Type B
  - a. UL listed and CSA Certified.
  - b. Conduit shall have a smooth inner diameter, and a smooth outer jacket approved for outdoor use.
  - c. Conduit shall be sunlight resistant and oil resistant.
  - d. Liquidtight fittings shall be designed for use with steel conduit or PVC conduit as required.
- 4. Conduit clamps, straps and supports shall be steel or malleable iron, hot dip galvanized.
- 5. Special Fittings: Conduit sealing, explosion-proof, dustproof, and other types of special fittings shall be provided as required by the Drawings and these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors or in damp locations shall be sealed and gasketed. Outdoor fittings shall be of heavy cast construction. Hazardous area fittings shall conform to UL 886 and to NEC requirements for the area classification designated.

### B. Wire and Cable

- 1. Sizes indicated on the Drawings.
- 2. Service-entrance cable shall have type RHW insulation.
- 3. Feeders and Branch Circuits:
- 4. Flame-retardant, moisture- and heat-resistant thermoplastic with single conductor copper cable, Type THHN/THWN, 600V.
- 5. Rated 75EC maximum conductor temperature in wet locations and 90EC in dry locations.

6. Conductor composed of 98% IACS, (International Annealed Copper Standards) soft annealed copper conforming to ASTM B8.
  7. Conductor insulated with polyvinyl chloride to conform to or exceed Insulated Cable Engineers Association (ICEA) Standards.
- C. Control Cable
1. Use size 14.
  2. Multiple-conductor shielded control cable, each conductor polyethylene insulated with a polyvinyl chloride covering and the cable having an overall polyvinyl chloride jacket.
  3. Rated 600V, 90EC maximum conductor temperature in wet and dry locations.
  4. Individual conductors composed of 98% IACS soft annealed copper, 7-wire stranded.
  5. ICEA Method 1 color coding, colored insulation, and printed, colored tracers.
- D. Connections to Equipment
1. Power Cable Connectors:
    - a. For all wire, cable, equipment and bus terminals, designed and sized for the specific cable or bus being connected.
    - b. Solderless, pressure-type connectors constructed of high-strength, non-corrodible, tin-plated copper designed to furnish high-pullout strength and high-conductivity joints.
    - c. Rated current-carrying capacity equal to, or greater than, the cable being connected and with silver-plated contact surfaces for conductors of 500-kcmil copper capacity or greater.
  2. Control Cable Connectors
    - a. For control, alarm, and instrumentation wiring, use pre-insulated, diamond-grip type with ring tongue. Spade lugs will not be permitted.
    - b. Designed for the specific size and type conductor being used.
- E. Wiring Devices
1. GFCI Receptacles
    - a. Rated 20A, 125 VAC, specification grade, NEMA 5-20R.
    - b. Flush-mounted, ivory color.
    - c. A contrasting color band on the reset button provides visible indication of a ground fault trip.
    - d. Duplex, arc-resistant and prewired, 3-wire, grounding-type.
    - e. Five milliamperes trip level, feed-thru type, capable of protecting connected downstream receptacles.
    - f. Provide matching cover plates.
    - g. Weatherproof receptacles shall be supplied with a die cast aluminum, spring held cover with a rubber, watertight gasket.
- F. Disconnects
1. Provide safety switches of the heavy-duty type and rating as shown on the Drawings or required for proper completion.
  2. Provide heavy-duty, dead-front, positive, quick-make, quick-break, fused type or non-fused, as indicated on the Drawings, rated 600 VAC for 480Y/277V system and 250 VAC for 240/120V system or 208/120V system.
  3. Switch shall be selected according to poles, amperes, volts and NEMA type enclosure as indicated on the Drawings.
  4. Unit shall be UL listed and externally operable with provision for padlocking.
  5. Provide copper contacts in safety switches.
  6. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open.

7. The operating handle shall be an integral part of the box, not the cover. The handle position shall indicate whether the switch is "ON" or "OFF".
8. The covers shall be securable in the open position.
9. NEMA 3R switches shall have interchangeable, bolt-on hubs. Hub connections shall be watertight, dustproof, and airtight.
10. The finish shall be a baked enamel gray, electrodeposited on cleaned, phosphated steel.
11. Provide enclosures clearly marked for maximum voltage, current, horsepower rating, NEMA Type 3R, raintight.
12. Fuse clips for fusible units shall accommodate Class R fuses.
13. Sources: General Electric; Siemens; Square "D"; Westinghouse

G. Fuses

1. Fuses shall be Class RK1, dual element, current limiting, one-time fuse, 250V or 600V as required per NEMA FU1 and UL 198E.
2. Interrupting rating shall be 200,000 amperes rms.
3. Sources: Brush; Bussman

H. Supporting Devices

1. Conduit or equipment supports shall be galvanized steel support channel adequate for the weight of equipment or conduit, including wiring, which they carry.
2. Fastening hardware shall be corrosion resistant.

I. Identification

1. Identify all safety switches and other apparatus used for operation and control of circuits, appliances, and equipment. Provide plastic laminate nameplates, white face with black core letters, showing proper identification. Minimum size nameplate shall be 1" x 3" with 1/4" letters. Labels shall be secured using silicone glue.
2. Wire and cable markers shall be printed tape markers or split sleeve type.

- J. Handhole/Junction Box: Handholes/junction boxes shall be fabricated from an aggregate consisting of sand and gravel bound together with a polymer and reinforced with continuous woven glass strands. The compressive strength shall be 11,000 psi, tensile strength of 1700 psi, and flexural strength of 7500 psi. The cover of the handholes must have a non-skid surface and must hold a vertical design load of 8000 pounds over 10' x 10" surface with no physical damage or excess deflection. The cover logo shall be "Lighting". Size per NEC. It shall be as manufactured by Quazite.

## 2.3 POWER SYSTEM

A. Grounding

1. Ground all power distribution equipment, branch circuit loads, etc. by conductor to the grounding system. All metallic parts of electrical equipment which do not carry current shall be grounded with an equipment grounding conductor whether or not shown on the Drawings. The equipment grounding conductor shall be a green insulated copper conductor. Sizes of grounding conductors shall be in accordance with the NEC unless shown otherwise on Drawings. The NEC shall govern and shall not be violated.

B. Provide the following wire for direct buried grounds

1. Bare, uncoated copper cable, unless otherwise noted.
2. Conductors composed of 98% IACS soft or annealed copper to conform to the following requirements:
  - a. 250 kcmil stranded, unless otherwise noted.
  - b. Solid conductors in sizes No. 4 AWG and smaller.
3. Sources: Anaconda; General Cable; General Electric; Triangle

- C. Ground Rods
  - 1. Copper-clad steel or copper alloy, sectional type rods.
  - 2. One end pointed to facilitate driving.
  - 3. 3/4" diameter and 10'-0" long with diameter and length stamped near top of rod.
- D. Connection Materials
  - 1. Cable-to-cable, cable-to-rod, cable-to-connector, and cable-to-building steel connections of exothermic welding process, unless otherwise noted.
  - 2. Cable-to-equipment ground lugs:
    - a. Bolted to equipment housing with silicon bronze bolts and lock washers.
    - b. All equipment grounding shall be free of paint or any other material covering bare metal.
  - 3. Sources: Cadweld; OZ/Gedney; Weaver
- E. Other Materials: The Contractor shall provide other materials, though not specifically described, which are required for a completely operational system and proper installation of the work.

**PART 3 EXECUTION**

- 3.1 LABOR AND WORKMANSHIP: All labor for the installation of materials and equipment furnished for the electrical system shall be done by experienced mechanics of the proper trades.
  - A. All electrical equipment furnished shall be adjusted, aligned and tested by the Contractor as required to produce the intended performance.
  - B. Upon completion of the work, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type of cleaner recommended by the manufacturer for the item being cleaned.
- 3.2 COORDINATION: Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
  - A. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total work.
  - B. Installation of exposed conduit, lighting fixtures, or other equipment shall not occur until all piping, pipe hangers, ducts and equipment which are above have been installed, and provided on site by others.
  - C. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members, mechanical items, or other equipment, provide required supports and wiring to clear the encroachment.
  - D. Coordinate installation of Owner-furnished equipment and placement of conduits using vendor Drawings, plans, and the established construction schedule.
  - E. Data indicated on the Drawings and in these specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels, and other conditions will be governed by actual construction and the Drawings and specifications should be used only for guidance in such regard.
  - F. The electrical Drawings are diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual

construction and the work of other trades, make such deviations without additional cost to the Owner.

- G. Perform trenching, bedding, and backfilling associated with the work of this Section in strict accordance with the provisions of Section 02210, EARTHWORK, of these specifications.

### 3.3 INSTALLATION

#### A. Conduits

1. Install using as few joints as possible.
2. Provide RGS conduit for all conduit penetrating concrete walls and floors and for all exposed, exterior conduit. Provide Schedule 80 PVC conduit where noted on the Drawings.
3. Provide Schedule 40 PVC or RGS conduit below grade, unless noted otherwise. Minimum burial depth outside of building shall be 24" clear to top of conduit, unless noted otherwise.
4. Install liquidtight nonmetallic conduit at all points of connection to equipment mounted on supports to allow for expansion and contraction or ease of maintenance.
5. The number of raceways shall be installed per Drawings. Circuits shall not be combined to reduce number of raceways.
6. Where conduit has to be cut in the field, it shall be cut square with a pipe cutter using cutting knives.
7. All conduits shall be swabbed clean by pulling an appropriate size mandrel through the conduit before installation of wire or cable. Clear all blockages and remove burrs, dirt, and debris.
8. Provide insulated grounding bushings for all conduits stubbed into equipment enclosures.
9. Where conduit size is not indicated, install ¾" conduit.
10. Plugs shall be installed in all unused openings of all fittings, boxes, and panel boards.
11. Contractor is responsible for protecting all conduits during construction. Temporary openings in the conduit system shall be plugged or capped to prevent entrance of moisture or foreign matter. Contractor shall replace any conduits and/or ducts containing foreign materials that cannot be removed.

#### B. Conductors

1. All wire shall be color coded as follows:

<u>Description</u>	<u>208/120 Volt</u>
Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green
2. Single conductor and multi-conductor cable shall not be bent to radii smaller than that specified by the manufacturer or by the National Electrical Code. Special pull boxes or oversized conduits shall be used to meet this requirement.
3. Pulling lubricants shall be soapstone powder, powdered talc, or a commercial pulling compound. No soap suds, soap flakes, oil, or grease shall be used, as these may be harmful to cable insulation. Contractor shall use nylon or hemp rope for pulling cable to avoid scoring the conduit.
4. Cables shall be neatly trained, without interlacing, and be of sufficient length in all boxes, equipment panels, etc. to permit making a neat arrangement. Jackets of multiconductor control cables shall be removed as required to properly train and terminate the conductors. Cables shall be secured in a manner to avoid tension on conductors or terminals, and shall be protected from mechanical injury and from moisture at the unprotected end. Sharp bends over conduit bushings are prohibited. Damaged cables shall be removed and replaced at the Contractor's expense.

#### C. Wiring Devices

1. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of the NEC and NEMA standards and in accordance with recognized industry practices.
2. Coordinate with other work as necessary to interface installation of wiring devices.
3. At time of completion, replace those items that have been damaged, including those burned and scored by faulty plugs.

D. Grounding

1. Install grounding system as shown on the Drawings.
2. Install ground rods as indicated on the Drawings, by driving and not by drilling or jetting.
3. Drive ground rods into unexcavated portion of the earth where possible.
4. Where ground rods must be installed in excavated areas, drive rods into earth after compaction of backfill is completed.
5. Drive to a depth such that the top of ground rods will be approximately 12" below finish grade, or subgrade, and connect to counterpoise.
6. Rotate each ground rod 180E for every foot it is driven to prevent undetected deflection. If it cannot be rotated, a new ground rod shall be driven.
7. Conform to manufacturer's instructions for grounding system connections. All ground connections shall be inspected for tightness. Exothermic-welded connections shall be approved before being permanently concealed.
8. Chemically degrease and dry connections completely before welding.
9. Apply one coat of asphaltic coating to all exothermic-welded connections to be buried.
10. Make connections to equipment as follows:
  - a. Make up clean and tight to assure a low-resistance connection with resistance drop not exceeding 1 ohm.
  - b. Install so as not to be susceptible to mechanical damage during operation or maintenance of equipment.
  - c. Provide direct copper connection to counterpoise.
11. A separate, continuous, insulated equipment grounding conductor shall be installed in all feeder and branch circuits.
12. A separate neutral conductor shall be installed for each branch circuit. Combining neutrals shall not be allowed.
13. Bond all insulated grounding bushings with a bare #6 AWG grounding conductor to a ground plate or ground bus.
14. All grounding conductors embedded in or penetrating concrete shall be insulated.

E. Control Panels

1. Unless otherwise shown on the Drawings, install control panel with the top of the trim 6'-3" above grade. Mount on channel as indicated.

F. Lighting Fixtures

1. Completely install lighting fixtures for use and shall be located as shown on the Drawings.
2. Wire fixtures with conductors which comply with paragraph - Wire and Cable.
3. Use only galvanized steel and galvanized hardware for fixture installation to provide protection against rust and corrosion.
4. Install all lighting fixtures so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building. Use adequate number and type of fastenings to assure safe installation.
  - a. Screw or toggle bolt fastenings to ceiling material or wall paneling are not acceptable.
  - b. Support fixtures directly from roof joists or roof trusses.
5. All luminaires shall be aligned and lenses and diffusers cleaned at the completion of the work. Failed lamps shall be replaced.

- G. Hazardous (Classified) Locations
1. All work in hazardous locations shall be completed in accordance to the NEC and as shown on the Drawings. In the case of conflicts, the contractor shall notify the engineer in writing and await for written instructions.
  2. All conduit shall be rigid galvanized steel, equivalent to Schedule 40 pipe. EMT and IMC, as defined in the NEC, shall not be used.
  3. Conduit sealing fittings shall be installed as required by the NEC.
  4. Drain seals shall be installed on vertical conduits immediately before entering equipment enclosures in order to prevent moisture from entering equipment. Drains shall be used at all low points in the conduit systems and as required to prevent accumulation of moisture in conduit and equipment enclosures. All conduits passing through building walls shall be sealed within 18" of outside walls.
  5. Conduit sealing fittings shall not be packed or poured until all systems have been inspected and tested.

### 3.4 ACCEPTANCE TESTING

- A. General
1. Provide personnel and equipment, make required tests, and submit test reports upon completion of tests.
  2. Provide temporary power source of proper type for testing purpose when normal supply is not available.
  3. Make written notice to the Owner adequately in advance of each of the following stages of construction:
    - a. In the underground condition prior to placing concrete floor slab, when all associated electrical work is in place.
    - b. When all rough-in is complete, but not covered.
    - c. After all exothermic-welded connections are made, but not concealed.
    - d. At completion of the work of this section.
  4. When material and/or workmanship is found not to comply with the specified requirements, the noncomplying items shall be removed from the jobsite and replaced with items complying with the specified requirements promptly after receipt of notice of such non-compliance.
- B. Test Procedures
1. All feeders shall have their insulation tested after installation, but before connection to devices. The conductors shall test free from short circuits and grounds.
  2. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections.
  3. After installation is complete, the equipment shall be demonstrated to operate satisfactorily and to conform to contract documents.
  4. Measure and record voltages between phases and between phase wires and neutrals. Submit a report of maximum and minimum voltages.
  5. Perform ground test to measure ground resistance of counterpoise. Resistance shall be 5 ohms or less.
- C. System Functional Test
1. Upon completion of equipment tests, a system functional test shall be performed. It is the intent of this test to prove the proper interaction of the power and control systems.

**END OF SECTION**

## SECTION 16905

### LIFT STATION CONTROLS AND INSTRUMENTATION

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. This Section includes control panels and instrumentation for pump stations\lift stations provided under this Contract. Provide materials, equipment, and installation.

##### 1.2 RELATED SECTIONS

- A. Section 11307 - Submersible Grinder Pump Station.
- B. Section 16050 - Basic Electrical Materials and Methods

##### 1.3 APPLICABLE PUBLICATIONS: Industry publications controlling the work of this Section include:

- A. American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE):
  - ANSI/IEEE C37.90: Surge Withstand (IEEE 472)
  - ANSI/IEEE C39.5: Safety Requirements
  - ANSI/IEEE C39.6: Digital Measuring Instruments
  - ANSI/IEEE S50.1: Compatibility of Analog Signals for Electronic Industrial Process Instruments.
- B. National Electrical Manufacturer's Association (NEMA):
  - NEMA FU 1: Low Voltage Cartridge Fuses.
  - NEMA ICS: Motor Starters.
  - NEMA WD 1: Wiring Devices.

##### 1.3 SUBMITTALS

- A. Submit the following under the provisions of Section 01300 - Submittals:
  - 1. Catalog cuts of all instrumentation.
  - 2. Catalog cuts, panel layout, and wiring diagrams of the station control panel and all of its major components.
  - 3. Control panel schematic
  - 4. A system functional test procedure for use in system functional compliance testing.
  - 5. Catalog cuts of the starters, selector switches, alternator, elapsed time meters, and indicator lights.
  - 6. Upon completion of this portion of the work, and as a condition of its acceptance, submit the following:
    - a. As-built drawings.
    - b. Copies of all warranties and guarantees.
- B. Submit operation and maintenance instructions under the provisions of Section 01700 - Contract Closeout. Include the following:
  - 1. Copy of the Record Documents for this portion of the work.
  - 2. Copies of all warranties and guarantees.
  - 3. Emergency instructions.
  - 4. Spare parts list.
  - 5. Wiring diagrams.

6. Shop drawings and product data.
7. Include the following information for equipment items:
  - a. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  - b. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions.
  - c. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

#### 1.4 SYSTEM DESCRIPTION

##### A. Duplex Pump Operation Using Primary Controller

1. The Float Switch Controller uses float switches to sense water level. Three floats are used to control the two pumps. The OFF float is positioned at the level below which both pumps are to be off. The LEAD float is set at the level at which the lead pump should come on. The LAG float is set at the level at which both pumps should be on.
2. As the water level in the wet well rises it will reach the LEAD float. When this float closes the lead pump is started. This pump should pump the level down until it reaches the OFF float. When the level is pumped down below the OFF float and it opens then the lead pump is stopped. If the lead pump fails to pump the level down and the level reaches the LAG float then the lag pump is started. With both pumps running the level is pumped down to the OFF float and both pumps are stopped. All of the floats are normally open (open if above water) type floats.
3. If the alternator switch on the front of the controller is in the center position then each cycle the lead and lag pump will be swapped so that pump starts and run time is equalized. If the alternator switch is in the 1-2 position then pump 1 will always be the lead pump. If the alternator switch is in the 2-1 position then pump 2 will always be the lead pump. A timer is built into the controller so that both pumps cannot be started at the same time. This insures that at least 8 seconds will elapse between pump starts, to prevent simultaneous starting after power failures if the level is high in the wet well.
4. The controller has provisions for two alarm floats, a high level alarm and a low level alarm. If the water level is below the LOW WATER CUT-OFF float then the low alarm light on the front panel will light, the low alarm relay will close and both pumps will be stopped if they are not already off. If the water level is above the HIGH float then the high alarm light on the front panel will light, the high alarm relay will close and both pumps will be started ( 8 seconds apart) if they are not on already. All of the floats are normally open (open if above water) type floats.
5. The controller has two pump fail inputs. When these inputs are closed the associated pump will be disabled and the other called in its place. When this condition exists a continuous red error light for that pump will illuminate on the front panel. The controller also has two pump warning inputs which are for submersible pump seal leak sensors. The warning inputs, when activated, cause the pump error light to blink but do not disable the pump. The error and warning inputs are optional and if not used should be left unconnected. The fail and warning inputs are completely isolated and intended to connect directly to the sensors in the pumps without the need for any sensing relays. All float and sensor inputs are designed to operate at voltages and currents well below the intrinsically safe limits.

##### B. Duplex Pump Operation Using Backup Controller

1. In this mode BACKUP START float is suspended in the wet well above the operating range of float switches for the primary controller.

2. If the primary controller should be unable to maintain the level below this point the float switch will close and the backup controller will be activated in the single float backup mode. When this happens the alarm relay will be closed and the alarm light and flasher will be illuminated and the alarm horn will sound.
  3. One of the pumps control relays will close calling one of the pumps. After a delay of 8 seconds the second pump control relay will close calling the second pump. The controller then waits for the level to pump down to a point where the float switch opens. After the high float switch opens the pumps remain on for a period of time selected by the delay time switches on the backup controller. After the delay has elapsed the two pumps will turn off. The alarm relay and lamp will remain energized. The backup controller will then wait for the high float to again close and repeat the above operation except that the two pumps will be called in the reverse order ( alternated ) to equalize pump wear. The delay time can be selected using 8 switches on the backup pump controller for a time between 0 and 255 seconds ( 4.25 min.).
- C. Motor Megger Function: Each time a pump is called to start the motor megger module will test the insulation of motor insulation. If the winding resistance is below the setpoint value, the pump will not start and the “Motor Megger Fail” indicating light will illuminate.
- 1.5 QUALITY ASSURANCE: All materials used shall be new, of high grade and of properties best suited to the Work required.
- A. Manufacturer’s Qualifications
    1. Controls shall be furnished by a UL recognized supplier.
    2. Controls shall be furnished by the pump supplier.
  - B. Coordination Responsibility
    1. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.
- 1.6 COORDINATION: Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- 1.7 SPARE PARTS: Provide the following spare parts for each type of material specified:
- A. Fuses - 3 of each type used
  - B. Indication Light Bulbs - 100%
  - C. Float switches - 2
- 1.8 WARRANTY
- A. Provide warranty under provisions of Section 01700 - Contract Closeout.
  - B. Controls Supplier shall furnish to the Owner a written warranty against defects in workmanship and materials for two (2) years. All parts shall be covered under warranty. Coverage shall be full and not prorated. Written warranty shall include the following provisions:
    1. Representative of Controls Supplier shall visit the site within two (2) working days after a problem is reported to Control Supplier’s office.
    2. Components replaced or repaired under warranty, if removed, shall be re-installed by Controls Supplier. Warranty shall be in printed form.

3. Damage resulting from natural events such as lightening may be excluded from warranty. However, if Supplier concludes that lightening damage is the cause of malfunction, Supplier shall present evidence of such to Owner and Engineer.

## **PART 2 PRODUCTS**

### **2.1 GENERAL PRODUCT REQUIREMENTS**

- A. Provide only materials that are new, of the type and quality specified, and free from defects and imperfections. Where Underwriters Laboratories Inc. has established standards for such materials, provide only materials bearing the UL label.
- B. All materials and equipment of the same type shall be made by the same manufacturer.
- C. All materials and equipment shall be acceptable to the authority having jurisdiction as suitable for the use intended.
- D. Provide all components specified herein for each lift station, unless otherwise noted.

### **2.2 PUMP CONTROL PANEL**

- A. Each lift station shall be furnished with a complete assembled and pre-wired control panel suitable for mounting as indicated on the Drawings. Each control panel shall contain all necessary components specified below for automatic operation, protection, and alarm indication.
  1. Each control panel shall have an "as built" wiring diagram or schematic attached to the inside face of the outer door of the control enclosure. The wiring diagram or schematic shall clearly indicate all equipment, devices, terminal designations, wire colors, and wire marking.
  2. All control panels shall be tested and inspected before delivery to insure complete and proper operation.
  3. Float switch operation shall be intrinsically safe.
- B. Enclosure: Control panel enclosure shall be NEMA 4X with integral pedestal base unit (one piece) with stainless steel hinges and pins, stationary inner panel (located at the back of the panel), and a deadfront hinged swing-out panel.
  1. Enclosure shall be made of .090 stainless steel or .125 aluminum with a light gray powder coat finish. (All holes in the aluminum shall be pre-cut or drilled prior to the powder coated to insure against corrosion). The outer door shall be hinged on the left side with heavy gauge stainless steel hinge and stainless steel pin. Stainless steel draw and turn latches shall be provided, One (1) with a locking hasp (the hasp shall accommodate a standard padlock) and five (5) without.
  2. Provide padlock with plastic shield over keyhole. Furnish 3 keys to Owner.
  3. The interior panels shall be .125 aluminum or 12 gauge steel with white powder coat finish. The swing out inner door panel and mounting hardware shall be finished with a white powder coat and be the manufacturers standard accessories. Hardware shall be 304 stainless steel. All screws bolts, washers, and nuts shall be stainless steel. All holes through the exterior of the enclosure or pedestal shall be sealed or include a sealing washer.
  4. The swing-out deadfront panel shall have cutouts sized for the lights, selector switches, pushbuttons, cutouts for circuit breakers, and thru-door disconnect. All cutouts shall be cut prior to powder coating and include a border of not less than ½" around each cutout, made of the 1/8", 2 part engraving plastic, with 1/4" letters describing the function of each component on the swing-out deadfront. The main breaker shall be interlocked with the swing-out deadfront panel to prevent opening interior deadfront panel unless the main breaker handle is in the off position.

5. A separate fused 120 volt fused cabinet heater with continuously operating fan and thermostat shall be installed inside the control enclosure to prevent internal condensation. Heater shall be sized to keep the panel interior a minimum of 5 deg. F above outside ambient.
6. An engraved nameplate with 3/8" upper case letters shall be affixed to each outer door of panels identifying each lift station by station number.
7. All components mounted on the back panel shall be accompanied by an identification name plate engraved with the component description. The letters shall be 1/4" and be unobstructed or visible while standing in front of the enclosure.
8. The pedestal shall be provided with 2 compartments below the main panel. The compartments shall be separated so not to allow gasses or air to pass from one compartment the other. The enclosure shall be separated from the pedestal by PVC or stainless steel cord grips. Below the lower component compartment and prior to the wetwell rigid seal-offs shall be provided for all conduits that enter the wetwell space. The pedestal shall have a cover which is securely attached with stainless steel screws.
9. An internal brace shall be provided for support of the externally mounted control transformer, and shall be minimum 2 x 2 x 1/4 stainless steel or aluminum. Control transformer shall not be mounted inside the enclosure.
10. Power supply wire shall be pre-wired from the main breaker to the terminal chamber in the pedestal, and provided with terminal lugs.

C. Wiring

1. Alpha or Belden 600V, 105EC, UL style 1015 wire or Houston Wire and Cable SI-57275, SIS Vulkene insulated switchboard wire. DC signal wiring shall be as specified in this Division.
2. Wire Sizes
  - a. No. 12 AWG, 41 strand, for all convenience outlets, interior lighting, and other similar loads.
  - b. No. 14 AWG, 41-strand, for low power loads of 115V or lower voltage.
3. Wire Markers
  - a. Plastic coated hot-stamped tube-type, wire markers for snug fit for wire size. Printed tape markers are not acceptable.
  - b. Identify both ends of wire with the same unique wire number.
  - c. Assign wire numbers where specific designations are not indicated.
4. Wire Terminals
  - a. All control wires shall be terminated with vinyl insulated pin terminals, copper with electroplated tin finish, Sta-Kon or equal, with 600V rating. Terminals shall be attached with proper crimping tool.
5. Wiring Methods
  - a. Route main groups of wires in plastic nonflammable wiring duct.
  - b. Smaller groups of wire shall be cabled and secured with nylon cable clamps and ties or plastic spiral wraps.
  - c. Route instrument dc signal wiring in separate ducts or groups from ac power and control wiring.
  - d. For equipment and Terminal Block Connections install terminals with tool as recommended by manufacturer to apply required amount of pressure correctly.
  - e. Solder Connections: Soldering iron used shall not exceed 100 W.
  - f. Provide terminal blocks for all external connections.
  - g. Provide neutral/ground bar shall be provided for termination of neutral and equipment ground connections.
6. Identification
  - a. Identify all apparatus used for operation and control of circuits, appliances, and equipment, including circuit breakers, control switches, and indicating lights

Provide plastic laminate nameplates, black face with white core letters, showing proper identification. Minimum size nameplate shall be 1" x 3" with 1/4" letters. Labels shall be secured using silicone glue in a neat and properly aligned manner.

- b. Wire and cable markers shall be type written vinyl self laminating markers, which have a clear overlay of vinyl and an aggressive adhesive for adhesion to the wire.

- 7. Power Cable: Power supply wire to the inner door shall be stranded welding cable with heavy sheath.

D. Terminal Strips

- 1. Provide all end caps, clamps, dividers, terminal numbers, DIN rails, and any other items necessary to provide the terminal strip assemblies. Within each terminal strip the terminals shall be numbered consecutively. All terminal strips shall be 5 mm polyamide type similar to the Phoenix contact UK series or Weidmueller W Series.

E. Switch Action Fuse Blocks

- 1. Rated 600V, 30-A.
- 2. Sectional type nylon or polypropylene blocks.
- 3. Strap screw contacts or tubular clamp contacts.
- 4. Pressure sensitive marking tape for terminal identifications.

F. Main Circuit Breaker: Main circuit breakers shall be of voltage and phase suitable for the pumps, U.L. 489 listed, CSA rated, quick-make, quick-break, thermal and instantaneous magnetic trip with symmetrical interrupting rating as required to meet Utility's short circuit ampacity. Main breaker shall be lockable.

- 1. Trip rating as indicated or recommended by manufacturer of equipment being protected.
- 2. Main circuit breakers shall have factory-set thermal overload characteristics, with thermal trip rating set to carry total lift station load, and an adjustable instantaneous magnetic trip.
- 3. The main breaker shall be interlocked with the swing-out deadfront panel to prevent opening interior deadfront panel unless the main breaker handle is in the off position.

G. Pump Circuit Breakers: Circuit breakers and motor circuit protectors shall be of voltage and phase for the pump, U.L. 508 listed, quick-make, quick-break, thermal and instantaneous magnetic trip with required RMS symmetrical interrupting rating to match the main circuit breaker.

- 1. Trip rating as indicated or recommended by manufacturer of equipment being protected.
- 2. Main circuit breakers shall have factory-set thermal overload characteristics, with thermal trip rating set to carry total pump load, and an adjustable instantaneous magnetic trip.
- 3. Pump motor circuit protectors shall have field-adjustable thermal overload relays set to correspond with pump motor full-load current and operating conditions, field adjustable instantaneous magnetic trip, and an auxiliary contact to open when the breaker unit opens, wired in the motor starter control circuit. In lieu of integral adjustable thermal overloads in the breaker unit, a separate 3-pole manual reset thermal bimetallic overload relay unit may be used in conjunction with the starter contactor.
- 4. Mount on a panel inside control panel in a readily accessible location.

H. Pump Motor Contactors: Pump motor magnetic contactors shall be full voltage, non-reversing or reversing as indicated, rated in accordance with NEMA standards, sizes and horsepower ratings.

- 1. Necessary auxiliary contacts required by means of starter or relay.
- 2. Auxiliary relay, 120 VAC contacts rated 6A up to 300V.
- 3. Square D "Type S, Class 8502" or equal. Alternate sources: Allen-Bradley Co.; Cutler Hammer; General Electric; Westinghouse.

I. Motor Controllers

- 1. Magnetic Starters

- a. Full voltage, non-reversing or reversing as indicated, rated in accordance with NEMA standards, sizes and horsepower ratings.
- b. Starters shall be horsepower rated.
- c. Solid state overload relays for overload, phase loss protection, phase unbalance. The relay shall have an LED power indication. It shall be resettable.
- d. Necessary auxiliary contacts required by means of starter or relay.

J. General-Purpose Control Relays

- 1. Control relays shall be 120 VAC general purpose plug-in type, furnished complete with front wired socket bases. Contacts shall be DPDT silver cadmium oxide, and rated 10 amp continuous at 120 VAC.
- 2. Time delay relays shall be 120 VAC general purpose plug-in type furnished complete with front wired socket bases. Contacts shall be DPDT silver cadmium oxide, rated 5 amp continuous at 120 VAC Time delay relays shall be "on delay" type (contacts operated on an adjustable delay after coil energization) and have an adjustment knob for field adjustment of time delay.
- 3. All control relays shall have an indicator light and check button.

K. Primary Pump Controller

- 1. Duplex Float Switch Controller shall be a microcomputer based device which automatically controls one or two pumps. The controller shall be designed to work with standard float switches, seal leak sensors and thermal switches in submersible pumps. All of the inputs shall be optically isolated. The unit shall be Digital Controls Corporation "Model 12036", or equal, and shall include the following features:
  - a. A built in alternator with selector switch.
  - b. One RS-232 serial port. If this port is connected to a telephone or radio modem the controller will function as both a pump controller and as a remote terminal unit in a SCADA telemetry system.
  - c. Five float switch inputs for the float switch modes.
  - d. Four error sensor inputs for pump failure.
  - e. Two warning sensor inputs.
  - f. Five relays for driving two motor starters, the high alarm lamp, the alarm horn, and the low alarm.
  - g. 15 indicator light emitting diodes (lamps) as follows: high water alarm horn, high water alarm light, pump 1 run, pump 2 run, low water alarm, pump 1 seal fail, pump 2 seal fail, pump 1 temp fail, pump 2 temp fail, pump 1 disable, pump 2 disable, high float closed, lag float closed, lead float closed, off float closed.
  - h. A power supply for system power.
  - i. One input for a horn mute switch.
- 2. The five float switch inputs shall be self powered and optically isolated. The floats should all be normally open ( closed when submerged ) type floats. The float switch inputs shall have the following specifications:
 

Voltage when open	12.0 Volts DC
Current when closed	.8 milliamps
Isolation	2500 V rms
- 3. The four error inputs shall be self powered and optically isolated. They shall be able to be directly connected to the seal leak sensor in a submersible pump or to thermal sensor or both. They shall have the following specifications:
 

Voltage when open	12.0 Volts DC
Max current	2.3 milliamps
Isolation	2500 Vrms
- 4. The two warning inputs shall be identical to the error inputs except that they shall not disable the pumps.
- 5. The controller shall have five relays ( pump 1, pump 2, high alarm, high alarm horn , and low alarm) which have the following specifications:

Contact Rating	10 Amps at 125 VAC
Breakdown Voltage	800 Vrms
Life	100,000 cycles minimum at max load 5,000,000 cycles unloaded

6. The Float Switch Controller shall be designed to run on standard line power. It shall be fused, surge protected, and transformer isolated. All internal power supplies are regulated. The system has the following input power requirements:

Input Voltage	115 VAC +/- 15% at 60 Hz. +/- 20%
Input Current	0.7 Amps Max
Transient protection	Metal Oxide Varistor

7. Mute Input: The Float Switch Controller shall have one input which is used to silence the high alarm horn. When it is shorted to ground the high alarm horn relay will be opened to stop the high alarm horn during a high alarm condition. The high alarm light relay will not be affected by this action. When the current high alarm condition is cleared the high alarm horn relay will again be armed so that any new high alarms will sound the horn.

L. Backup Pump Controller

1. The backup pump control system shall automatically control up to two pumps, and shall also have the ability to function as a primary float switch controller. It shall have four possible modes of operation, three backup and one primary. It shall automatically select the appropriate mode of operation. When operating as a backup controller it shall only call for a pump if the primary controller failed to maintain the wet well level within normal operating limits. If the backup controller senses that the level has exceeded the primary control upper limit then it will take over and operate the pumps. When the backup controller takes over control it sets an alarm relay and lamp which will not clear until the backup controller is manually reset. The backup controller shall have the ability to function with either one or two float switches, or with three switches when operating as a primary controller. The unit shall be Digital Controls Corporation "Model 11946", or equal, and shall include the following features:

- Five float switch inputs for the float switch modes.
- Three relays for driving two motor starters, and the alarm.
- Four indicator light emitting diodes (lamps). Two for pump 1 and pump 2 and one for alarm and a blinking OK light for normal standby mode.
- Eight switches for setting the delay time.
- A microcomputer.
- A power supply for system power.
- A reset push button for clearing the alarm.
- A 50 Ma. 12 volt battery charger.
- Eight switches for setting the delay time for the single float backup controller mode. (0 to 255 seconds.)
- An optional pressure transducer for measuring stand tube pressure.

2. The backup pump control system shall have three relays which have the following specifications:

Contact rating	10 amps at 125 VAC
Breakdown voltage	800 Volts RMS
Life	100,000 minimum cycles at rated load 5,000,000 cycles unloaded

3. The backup pump control system shall have 4 LED indicators which have the following functions:

OK:	Flashes green when the system is operating normally and the backup controller has not been called.
PUMP 1:	Illuminates yellow when pump 1 has been called by the backup controller.
PUMP 2:	Illuminates yellow when pump 2 has been called by the backup controller.

- ALARM: Illuminates red when the backup controller has been called.
4. Input Power: The system is designed to operate with an external 12 Volt transformer.
    - Input Voltage 12 VAC + 50% - 10%
    - Input Current 1 amps max
    - Input power is transient protected and current limited. Transient protection is a metal oxide varistor. The power system is regulated.
  5. The Backup Pump Controller shall have a built in battery charger which is intended to charge a 12 Volt sealed lead acid battery for use in maintaining the alarm system or a SCADA remote terminal unit. Charging current shall be 50 Milliamps.
- M. Pushbuttons, selector switches, and indicating lights: Pushbuttons and selector switches shall be U.L. listed, heavy-duty oil tight, and shall be in accordance with NEMA ICS.
1. Pilot Lights: Provide pilot lights for each pump, for "Run", "Seal Moisture", and "Motor Temperature" conditions. Provide also on each for "High Water Alarm", "Low Water Alarm", and operation of each float switch.
    - a. Heavy-duty NEMA 4x rated.
    - b. Full voltage type.
    - c. Color caps as follows: Amber for "run", green for float switches, red for level alarms, motor over-temperature, and seal moisture.
    - d. Push-to-test type.
  2. Selector Switches
    - a. Three position switch operator shall be non-illuminated, with a black gloved hand knob, and lockable.
    - b. The switch arrangement and legend plate shall be as indicated.
    - c. Shall be UL and NEMA Type 4X.
    - d. Source: Class 9001 Type SK-30.5 mm as manufactured by Square D or Engineer approved equal.
- N. Elapsed Time Meters: Provide for each pump. Meters shall be mounted inside the enclosure on the interior dead front.
1. Non resettable.
  2. Panel mounted.
- O. Mounting of Relays and Control Devices
1. Complete accessibility to all terminals, relay sockets, and other devices without dismantling of panel equipment.
  2. Do not block access to any instruments or control devices mounted on face sheet.
  3. Installed on swing-out panels if necessary.
  4. Mount all diodes, resistors and similar equipment between terminal points on terminal blocks.
- P. Lightning arrester: A lightning arrester shall be connected to the incoming power terminals. Arrester shall be U.L. listed, and CSA Certified, rated 650 volts AC to ground for voltage and phase for the pump, 3-wire services. Arrester shall be mounted on exterior of cabinet. Square D "SDSA 1175" for single phase applications, and "SDSA 3650" for three-phase applications, or equal.
- Q. Phase monitor: Provide for each lift station, three-phase or single phase as applicable. Power monitor shall be a panel-mounted unit designed to continuously monitor the three-phase, voltage as applicable, 60 Hz power source for abnormal conditions. Unit shall protect against: phase loss, low voltage, phase reversal, voltage unbalance, and high voltage. Unit shall be RK Electronics "Single Phase Voltage Monitor", or equal, and shall have the following features:
1. LED readout.
  2. Time delays as follows: Pick-up of 0.1 seconds, and Drop-out of 0.2 seconds.

3. Isolated 5 amp SPDT relay contacts.
  4. Undervoltage shall be adjustable to 12% below maximum nominal voltage.
  5. Overvoltage shall be adjustable to 12% above maximum nominal voltage.
  6. Operating temperature of unit shall be 0°C to +40°C.
- R. Ground fault circuit interrupter: A ground fault circuit interrupting receptacle shall be mounted flush with the side of the pedestal enclosure, to provide 120 VAC power for maintenance personnel at each lift station site. GFCI receptacle shall be U.L. listed, meet U.L. class A tripping requirements, and have a NEMA 5-15R configuration. GFCI receptacle shall have a test/reset button.
- S. Alarm beacon and Audio Alarm: Alarm beacon mounted on panel enclosure and at remote location as indicated on the drawings shall be a U.L. listed, weatherproof, 120 VAC flashing beacon light with an amber colored shatter resistant acrylic dome and stainless steel dome bands. Flash rate shall be 60 to 80 flashes per minute. Beacon lamp shall be a bayonet type #25T8DC rated at 200 hours. Alarm beacon shall be suitable for mounting on ½" rigid galvanized steel conduit. An audio alarm shall also be provided.
- T. All equipment and devices shall be rated for operation in an ambient temperature of 50EC, minimum.

### 2.3 CONTROL DEVICES

- A. Level controls: Level controls for automatic pump operation shall be mercury displacement switches encapsulated in solid polyurethane foam floats, approved by Underwriter's Laboratories, Inc. for hazardous atmospheres. The switch circuitry shall be designed to operate with intrinsically safe relays located in the control panel.

### 2.4 ELECTROMAGNETIC FLOWMETER

- A. Provide one electromagnetic flow meter, complete with signal converter, cables, and other accessories required for a complete and functional installation. Flowmeter shall be a Danfoss "Mag 3100 W" with "MAG 500" signal converter, or approved equal. Flowmeter shall be installed in a meter pit as indicated on the Drawings. Signal converter shall be installed in the pump control panel and wired to a source of control power.

B. Meter Design Specifications:

- |     |                               |                                       |
|-----|-------------------------------|---------------------------------------|
| 1.  | Type:                         | Sensor with ANSI Class 150 flanges    |
| 2.  | Body material:                | Carbon steel with 2-component coating |
| 3.  | Connection Size:              | 2-inch                                |
| 4.  | Required metering flow range: | 15 - 100 gpm                          |
| 5.  | Liner:                        | Neoprene                              |
| 6.  | Temperature rating of medium: | 32 to 200 deg F                       |
| 7.  | Ambient temperature rating:   | -40 to 210 deg F                      |
| 8.  | Operating pressure:           | 0.15 to 600 psia                      |
| 9.  | Excitation frequency:         | 3.125 Hz                              |
| 10. | Enclosure rating:             | NEMA 6                                |
| 11. | Earthing electrodes:          | AISI 316 Ti                           |

C. Signal Converter Design Specifications:

- |    |                    |                    |
|----|--------------------|--------------------|
| 1. | Accuracy:          | 0.5%               |
| 2. | Supply voltage     | 115-230V a.c.      |
| 3. | Power consumption: | 9 VA at 230V a.c.  |
| 4. | Current outputs:   | 0-20 mA or 4-20 mA |

5.	Digital outputs:	Active or passive
6.	Relay output:	One, adjustable function (error, direction/limit, etc.)
7.	Totalizers:	Two 8-digit counters; forward, net, or reverse flow
8.	Display	Backlit alphanumeric, 2 lines x 20 characters Reverse flow indicated by negative sign.
9.	Zero point adjustment:	Automatic
10.	Galvanic isolation:	All inputs and outputs
11.	Enclosure:	Insert type for mounting through panel deadfront IP 20 enclosure rating

D. Additional Features:

1. Flowmeter shall have a sensorprom unit which stores sensor calibration data and signal converter settings for the lifetime of the meter. At commissioning the flowmeter shall commence metering without any initial programming. User specified settings shall be downloadable to the sensorprom unit. If the signal converter ever needs to be replaced, the new converter shall be able to upload all previous settings and resume measurement without any need for reprogramming.
2. Signal converter shall have the following functions: Flowrate, totalizer, low flow cut-off, empty pipe cut-off, flow direction (uni- or bi-directional), error system, operating time, limit switches, pulse output.
3. Equalization of sensor potential shall be accomplished effectively and completely. Manufacturer may offer built-in grounding electrodes for equalization. If this method does not prove adequate, a grounding flange shall be furnished, installed, and properly grounded and bonded at no additional cost to Owner.

2.5 FLOW COUNTER

- A. Provide an 8-digit non-resettable electro-mechanical counter and install on the outside of the pump control panel enclosure. Counter shall receive a pulse signal from the flowmeter's signal converter. Pulse size and counter units will be selected by Engineer. Counter shall be wired to control power in the pump control panel.

2.6 HIGH VISIBILITY STROBE LIGHT

- A. Provide a high-intensity strobe warning light for communication of pump station alarms. Strobe light shall be wired from and mounted on the control panel. Strobe light shall activate as a common alarm.

- B. Strobe light shall be Federal Signal Corporation "Starfire 131 DST" with the following specifications:

1.	Voltage:	120 VAC
2.	Flash Rate:	80 per minute, double flash
3.	Candlepower:	1,000,000 peak, 1,200 effective
4.	Lamp life:	2,000 hours
5.	Temperature rating:	-40 deg F to 149 deg F
6.	Dome color:	Amber
7.	Dome type:	High strength Lexan Fresnel dome
8.	Lamp base:	Anodized aluminum
9.	Enclosure rating:	NEMA 3R
10.	Overall size:	5-11/16" dia x 8-1/2" high
11.	Mount:	1/2" Pipe

2.7 CAPACITOR START KIT

- A. Provide for each pump a capacitor start kit with starting and running capacitors. Capacitors shall be in separate enclosures for each pump within the panel enclosure. The kit shall be removable from the panel as a unit without the use of tools.

### **PART 3 EXECUTION**

3.1 **LABOR AND WORKMANSHIP:** All labor for the installation of materials and equipment furnished for the electrical system shall be done by experienced workman of the proper trades.

- A. All electrical equipment furnished shall be adjusted, aligned and tested by the Contractor as required to produce the intended performance.
- B. Upon completion of the work, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material, and using only the type of cleaner recommended by the manufacturer for the item being cleaned.

3.2 **COORDINATION:** Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

- A. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total work.
- B. Data indicated on the Drawings and in these Specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels, and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.
- C. Verify all measurements at the job sites. No extra compensation will be allowed because of dimensional differences between the drawings and actual measurements at the site of construction.
- D. The electrical Drawings are diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Where deviations are required to conform with actual construction and the work of other trades, make such deviations without additional cost to the Owner.

3.3 **INSTALLATION**

- A. All installation practices shall be in accordance with the listed codes, standards, and manufacturer's recommendations.
- B. **Hazardous (Classified) Locations**
  - 1. All work in hazardous locations shall be completed in accordance to the NEC and as shown on the Drawings. In the case of conflicts, the Contractor shall notify the Engineer in writing and await for written instructions.
  - 2. All conduit shall be rigid galvanized steel, equivalent to Schedule 40 pipe. EMT and IMC, as defined in the NEC, shall not be used. Schedule 80 PVC shall be used only where specifically noted on the Drawings.
  - 3. Conduit sealing fittings shall be installed as required by the NEC.
  - 4. Drain seals shall be installed on vertical conduits immediately before entering equipment enclosures in order to prevent moisture from entering equipment. Drains shall be used at all low points in the conduit systems and as required to prevent accumulation of moisture in conduit and equipment enclosures. All conduits passing through building walls shall be sealed within 18" of outside walls.

5. Conduit sealing fittings shall not be packed or poured until all systems have been inspected and tested.
- C. Pump Power Wire Terminations: Terminations of pump power wires shall be made in the terminal chamber of the pedestal base, using aluminum-copper one-hole lugs rated 235 kV, 600V, with crimped connection. Crimps shall be made with proper crimping tool approved by manufacturer. Surfaces of lugs shall be clean and smooth, and before termination shall be cleaned with connection cleaner and not touched with hands after cleaning. Completed connections shall be taped with rubber tape rated for 600V, then covered with two layers of 3M "Super 88" tape. Tape shall be wrapped tightly with no voids.

### 3.4 ACCEPTANCE TESTING

- A. General
1. Provide temporary power source of proper type for testing purpose when normal supply is not available.
  2. When material and/or workmanship is found not to comply with the specified requirements, the noncomplying items shall be removed from the job site and replaced with items complying with the specified requirements promptly after receipt of notice of such non-compliance.
- B. Test Procedures
1. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections.
  2. The control and instrumentation circuits shall be demonstrated to operate satisfactorily and to conform to contract documents.
- C. System Functional Test
1. Upon completion of equipment tests, a system functional test shall be performed.

### 3.5 CONTROL PANEL SCHEDULE

- A. WRIGHT CITY MODOT Pump Station: Duplex pump control panel shall be provided with the following major features. This list is not intended to be all-inclusive, but is presented as an aid in bidding and construction of the panel. Panel shall be constructed as specified herein and as required for a complete and fully functional installation:
1. Pedestal enclosure. Refer to Drawings for elevation view of deadfront panel.
  2. Main circuit breaker.
  3. Phase monitor.
  4. Single-phase Lightning arrestor.
  5. Circuit breaker and motor contactor for each pump.
  6. Motor megger for each pump.
  7. Seal fail relays for each pump.
  8. Elapsed time meters for each pump.
  9. Primary Pump Controller, with face mounted through deadfront.
  10. Backup Pump Controller, with 12 volt battery backup, charger for alarm system.
  11. 12-volt alarm beacon and horn.
  12. Switches, indicating lights, and fuse holders as indicated on the elevation view of panel deadfront.
  13. Terminal strip for alarm contacts. Each alarm condition shall be provided with a set of normally open dry contacts on a common terminal strip. Alarm contacts shall include:
    - For each pump: Seal failure, motor over temp, megger fail
    - High water level
    - Low water level

Power fault (phase monitor alarm)

14. Flowmeter signal converter with face installed through deadfront panel.
15. Flow counter installed through side of panel enclosure.
16. Space in control panel for future autodialer.
17. High visibility strobe light ( mounted on panel and at remote location)
18. 3 Kva Central Power Transformer.
19. Capacitor start kit for each pump.

**END OF SECTION**