

**TECHNICAL SPECIFICATIONS  
FOR  
FRUITLAND REST AREA  
LAGOON IMPROVEMENTS**

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END OF DOCUMENT 00001

DOCUMENT 00005  
CERTIFICATIONS PAGE

	<p>I hereby certify that the following divisions of the following technical specifications of this engineering document were 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>Dennis E. Stith</u> Date: <u>2/28/12</u> Name: <u>Dennis E. Stith</u> Missouri License No.: <u>E-20058</u> My license renewal date is <u>December 31, 2012</u> Pages, Sheets, or Divisions covered by this seal: <u>Division 0 and 1 of the Bid Documents</u> <u>Division 1 - Sections 01012, 01300, 01400, 01500, 01600, 01650 &amp; 01700</u> <u>Division 2 - Sections 02220, 02732, &amp; 02922</u> <u>Division 3 - Section 03300</u> <u>Division 11 - Sections 11308 &amp; 11309</u></p>

DOCUMENT 00005  
CERTIFICATIONS PAGE

	<p>I hereby certify that the following division of the following technical specifications of 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>Dale K. Dickson</u> Date: <u>5/18/12</u></p>
	<p>Name: <u>Dale K. Dickson</u></p>
	<p>Missouri License No.: <u>E23058</u></p>
	<p>My license renewal date is <u>December 31, 2012</u>.</p>
	<p>Pages, Sheets, or Divisions covered by this seal: <u>Division 16 - Sections 16050 &amp; 16905</u></p>

END OF DOCUMENT 00005

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LIST OF DRAWINGS

Drawings are not bound in this book.

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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 an ultraviolet disinfection unit, gravity intermittent sand filter, sludge and submerged sand filter removal and installation of aerators in the MODOT Fruitland Rest Area. 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. Install gate valve between cells 2 and 3.
  2. Dewater cell #3, sludge and submerged sand filter removal.
  3. Contractor shall be responsible for removal of additional water should cells #1 and #2 become too full during construction.
  4. Concurrently install intermittent sand filter, UV disinfection unit and aerators in cell #1.
  5. Startup of equipment.
  6. Complete construction and restoration.

#### 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 owning 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

## 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.

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. MoDOT Personnel will perform inspection work.
- 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 EXECUTION

#### 2.1 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.

## 2.2 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.

1.2 TEMPORARY ELECTRICITY

- A. Coordinate with MoDOT personnel.

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.

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.

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 FIELD OFFICES AND SHEDS

- A. NOT APPLICABLE

1.15 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.

**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 01300 – Submittals
- B. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.
- C. 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**

## SECTION 02220

### EARTHWORK

#### PART 1 GENERAL

##### 1.1 SUMMARY

This section applies to open cut and trenchless sewer installation, as indicated on the Drawings. The Contractor shall perform all excavation, embankment, trenching, backfilling, cushioning, surface dressing, dewatering, shoring, 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 preparation
- D. Excavation and trenching
- E. Backfill
- F. Tracer Wire
- G. Earthfills and Embankments
- H. Impervious Trench Check
- I. Soil Testing

##### 1.3 RELATED SECTIONS

- A. Section 02732 - Sanitary Sewer System

##### 1.4 REFERENCES

- A. 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.
  - 1. ASTM D-698 Moisture-Density Relations Of Soils, Using 5.5 Pound (2.5 kg) Rammer And 12-Inch (304.8 mm) Drop
  - 2. ASTM D-1140 Test Method for Amount of Material in Soils Finer Than the No. 200 (75Fm) Sieve.
  - 3. ASTM D-2922 Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
  - 4. ASTM D-3017 Standard Test Methods for Water Content of Soil and Rock by Nuclear Methods.

##### 1.5 SUBMITTALS

- A. The Contractor shall submit the following items, in accordance with Section 01300 - Submittals:
  - 1. 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 trench backfill material placed under, around, and in some cases over the pipe. The material type and extent of embedment is specified in the respective pipe section.
- 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. Structural backfill: Structural backfill is defined as soil or stone aggregate material placed around or above subsurface structures, such as manholes, vaults, foundations, and wetwells.

## 1.7 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 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.

## 1.8 TREE REMOVAL

- A. It is the intent of these specifications to minimize tree removal.
- B. No trees outside of established permanent easements are to be damaged or removed without the express approval of the Owner. Contractor shall make every effort to minimize tree damage and removal, whether inside or outside easements. Contractor shall endeavor to work around and between trees.
- C. All trees, brush, etc., shall be disposed of by the Contractor as specified herein.
- D. Trees shall be removed in such a manner that will prevent damage to trees left standing, to existing structures, utilities, paved roadways, curbs and walkways, and with due regard to the safety of employees and others.
- E. Surfaces of trees that are cut or scarred by the Contractor's operations shall be painted with an approved asphaltum base paint prepared especially for tree surgery.

## 1.9 SITE PREPARATION

- A. 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.
- 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.

- C. All abandoned pipe conduit within the limits of grading shall be removed by the Contractor.
- D. New pipe conduits shall be stockpiled at a location designated by the Owner.

1.10 NOT USED

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 TRENCH BACKFILL MATERIALS

- A. Pipe embedment materials shall be as specified for the particular pipe material.
- B. Random Backfill Material
  - 1. Random backfill material shall be trench excavated soil material which is free from organic material, debris, and rocks or lumps larger than 6 inches in their greatest dimension.
- C. Select Backfill Material
  - 1. Select backfill material shall be a sorted, job-excavated soil material as specified for random backfill material, except no rocks, stones, or lumps larger than one inch in largest dimension shall be present.
- D. Granular Backfill Material
  - 1. Granular backfill material shall be a graded gravel or crushed stone of the following gradation:
 

Sieve Size (square opening)	Percent Passing (by weight)
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 backfill material shall be free from clay lumps or organic matter. The fraction passing the No. 40 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.3 EARTHFILL AND EMBANKMENT 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.
- 2.4 TRACER WIRE: 12 gauge TW copper.
- 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 SITE PREPARATION

- A. Clearing and stripping: All vegetation and other unsuitable material within the grading limits shall be stripped or otherwise removed before excavating. Likewise, six inches of topsoil shall be stripped from the disturbed construction areas and stockpiled for later use in final grading.
- B. 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.
- C. Adjustment Maintenance: 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 Supplemental General Conditions, 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.

#### 3.2 EXCAVATION AND TRENCHING

- A. Sheeting and bracing
  - 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.
  - 2. 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.
- B. Trenching
  - 1. The Contractor shall not open more trench in advance of the pipe laying than is necessary to expedite the Work. The length of open trenches shall be limited depending on the nature of the soil and safety considerations. The length from one manhole to the next or 375 feet, whichever is the shorter, shall be the maximum allowable length of open trench

- ahead of pipe laying. All open trenches shall be adequately protected using fencing, barricades, etc. as required.
2. 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. 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.
  4. In those areas designated to be landscaped, seeded or sodded, the top soil shall be excavated, stockpiled and replaced as specified herein.
  5. 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.
  6. 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 embedment. However, the limiting trench widths below an elevation 12 inches above the top of the installed pipe shall be as follows.

Pipe Size (inches)	Minimum Trench Width in Earth (inches)*	Maximum Trench Width in Earth (inches)	Minimum Trench Width in Rock (inches)*
<4	20	26	20
4-6	24	30	24
8	26	32	24
10	30	34	24
12	32	36	26

\*Note: Minimum trench width given is for gravity sewer construction.

Minimum trench width for sewage force mains and other conduits which do not flow by gravity shall be (for open-cut construction methods):

- a. For very small pipes (3-inch diameter and smaller): Pipe diameter plus 6 inches. For pipes installed by mechanical trenchers, smaller trench widths will be allowed.
- b. For small pipes (6-inch diameter and smaller): Pipe diameter plus 8 inches.
- c. For large pipes (8-inch diameter and larger): Pipe diameter plus 12 inches.

For forcemains installed by mechanical trenching devices shall have a trench width as narrow as possible.

7. 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 tables, 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.
8. Excavation below trench subgrade:
  - a. Over excavation due to Contractor's oversight shall be backfilled with granular embedment material as required at no additional cost to the Owner.
  - b. When unstable or unsuitable material is encountered in the trench subgrade, such material shall be removed, backfilled with granular pipe embedment material 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.
- c. When the trench bottom is soft and in the opinion of the Engineer cannot support the pipe, a further depth and/or width shall be excavated and refilled to the desired pipe foundation grade with granular embedment material as required by the Engineer to assure a firm foundation for the pipe. Such excavation and backfill shall be done at no additional cost to Owner.
  - d. Where granular embedment material is not available, and in locations directed by the Engineer, granular backfill material shall be used to stabilize or raise the trench subgrade.
9. 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.
  10. 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.
  11. 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.

### 3.3 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 and according to the trenching and bedding details on the Drawings.
2. Embedment: Pipe embedment shall be placed as specified for the pipe to be laid. Backfill placed on pipe embedment within one foot above the top of the pipe bell or coupling shall contain no excavated rock, rocks greater than 2 inches in largest dimension, or debris.
3. 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 structure.
4. If backfilling operations do not meet the specifications, the material shall be removed, replaced and recompact at the Contractor's expense.
5. 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.
6. No backfill shall be placed over or around any structure until the concrete or mortar has attained a minimum compressive strength of 2000 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 all bore pits, trenches in graveled areas, or other vehicle traveled ways which are either paved or surfaced with chip-and-seal material or gravelled:
  - a. Select backfill material shall be placed on the compacted pipe embedment, in layers not to exceed 12 inches in compacted thickness.
  - b. Random backfill material shall be compacted to a minimum of 95 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.

Random 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 backfill material shall be placed on the compacted pipe embedment, in layers not to exceed 18 inches in compacted thickness.
  - b. Random backfill 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. Random 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. Contractor shall refill these areas as needed to finish grade throughout warranty period.
  - c. Small pipelines installed by mechanical trenching devices may use dumped backfill, in which case the backfill shall be mounded to compensate for settlement.

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 shall be select backfill 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.

3.4 TRACER WIRE AND WARNING TAPE:

- A. Tracer wire and warning tape shall be placed in the trench for all plastic sewage force mains. Tracer wire shall be # 12 THHN copper, insulated wire. Refer to the trench details on the Drawings.

3.5 EARTHFILLS AND EMBANKMENTS

A. Material and Compaction Requirements

1. Fill areas which are below structures, roadways, or concrete slabs, and within 5 horizontal feet of a structure, roadway, 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 plus 2 or minus 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 plus 3 or minus 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 plus 2 or minus 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 proofrolled with a loaded tandem axel dump truck, or other equipment acceptable to Engineer. Unstable materials located by proofrolling, 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.

**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.
- 1.4 UNIT PRICE - MEASUREMENT AND PAYMENT
- A. Refer to Section 01025 - Measurement and Payment.
  - B. 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 polyvinyl chloride (PVC) compounds, and ASTM D-3034 for 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 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 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 adapters 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.
- 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 tail 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, and the details on the Drawings.
- B. Embedment for PVC pipe shall extend 4 inches below the pipe to 6 inches above the top of pipe, and shall be the full width of the trench. Embedment over rock shall include 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 silver, 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							
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.

**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. Arundines)	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 ½" 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°F and 100°F for at least seven days.
- F. Concrete shall not be placed on iced or frozen subgrade or when the air temperature is below 20°F. Concreting shall not be continued when the air temperature is below 45°F unless the following conditions are attained:
  - 1. Mixing water shall be heated (to a maximum of 150°F).
  - 2. Aggregates shall be heated until free of all ice and frost.
  - 3. The concrete temperature after mixing shall be between 50°F and 70°F if the air temperature is 20°F to 45°F.
  - 4. After the concrete is placed, it shall be covered, protected, and heated so as to maintain a minimum of 70°F air temperature for the first 24 hours and 50°F 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°F. Cover, protect and cool work as required to maintain the temperature of the concrete below 100°F. The concrete temperature, after mixing, shall not be greater than 85°F. 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 11308

### LAGOON AERATORS

#### PART I GENERAL

##### 1.1 SECTION INCLUDES

- A. General: This specification defines an electric motor-driven propeller-type, horizontal, aspirating aerator. The aerator induces the flow of atmospheric air below the surface of the water and provides flow-linkage mixing in multiple unit arrangements.
- B. Single Source: The aeration and controls shall be the product of a single supplier.
- C. System Description:
  - 1. The aerators shall consist of an electric motor drive above the water surface. The motor is connected to a hollow shaft within a protective housing positioned at a 35-degree angle downward into the water. Aerators with submersible motors are not acceptable.
  - 2. The shaft shall be connected to and drive a propeller beneath the water surface. The propeller shall thrust water past a diffuser to induce a pressure differential, drawing air through intake holes above the water surface down through the rotating hollow shaft and diffuser into the water. Solid shafts are not acceptable.

##### 1.2 RELATED SECTIONS

- A. Section 02732 - Sanitary Sewer System
- B. Section 03300 - Miscellaneous Concrete.
- C. Division 16 - Electrical

##### 1.3 REFERENCES

- A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:
  - 1. The air will be dispersed as fine bubbles (2.0-2.5 mm diameter) as defined by the U.S. EPA Report Number EPA-600/2-82-003. The Manufacturer shall verify compliance. If alternate-manufacturer cannot verify compliance via documentation from an independent engineering firm or the EPA, they shall be deemed coarse bubble and not be in compliance of bid specifications.
  - 2. The equipment Manufacturer shall provide written calculations showing all assumptions made in the design of the system.

##### 1.4 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 aerator and motor manufacturers.
- C. Submit descriptive literature, including a cross-sectional view of each aerator and motor

combination, which indicates materials of construction, weights, principal dimensions and other important details.

- D. Submit operation and maintenance data under provisions of Section 01300-Submittals and Section 01700 - Contract Closeout.
- E. Record Drawings: Submit record drawing under provisions of Section 01700-Contract Closeout.
- F. Submit copy of warranty.

#### 1.5 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.

#### 1.6 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.
- D. Store all equipment off the ground in enclosed shelter.
- E. Aerator shall arrive at the installation site fully assembled and ready for attachment to the floatation or support equipment.
- F. Aerators with couplings that can become misaligned during shipment are not acceptable.

#### 1.7 WARRANTY

- A. The aerator Manufacturer shall supply a 1-year non-prorated factory warranty.
- B. All parts supplied by the aerator Manufacturer must be warranted the same.
- C. Field replacement of the aerator components shall in no way effect the factory warranty.
- D. The warranty repairs must be done in accordance with the factory O & M manual.

PART 2 PRODUCTS

2.1 GENERAL

- A. The equipment shall be manufactured by Aeration Industries International, Inc., AEROMIX, or pre-approved equal.

Aeration Industries International, Inc.  
P.O. Box 59144  
Minneapolis, MN 55459-0144  
(952) 448-6789  
[www.aireo2.com](http://www.aireo2.com)

Aeromix  
7135 Madison Ave. West  
Minneapolis, MN 55427-3677  
(763) 746-8400  
[www.aeromix.com](http://www.aeromix.com)

- B. Major portions of this specification are written around the Aeration Industries equipment, however the Aeromix unit shall be considered an equal unit.
- C. Any additional alternate equipment Manufacturer shall be approved at least two (2) weeks prior to the bid date.
- D. All equipment Manufacturers shall have a minimum of five installations of the same equipment model and design in a similar application for a period of five years. A reference list shall be provided with names, telephone numbers, and addresses of the qualified installations.

2.2 AERATOR COMPONENTS:

A. AERATOR DRIVE MOTOR

1. The motors shall deliver 2 horsepower at and shall be rated for 240 volts, 60 cycle, single phase service. Motors shall be specifically designed for operating angle of 35°.
2. The motor shall be totally enclosed, fan cooled.
3. The motor shall, in all cases, equal or exceed current NEMA specifications.
4. The motor windings shall be nonhygroscopic.
5. Insulation shall equal or exceed NEMA Class F with Class B temperature rise.
6. A service factor of 1.15 shall be furnished.
7. A condensate drain shall be located at the lowest point in the lower end-bell housing.
8. A stainless steel nameplate shall be provided with each motor and shall be securely fastened thereto. Information shall include voltage, speed, phase, insulation class, amperage, service factor, wiring diagram, and motor serial number.
9. The motor shaft shall be balanced to within 1 mil to be measured on any part of the motor frame including the C-face.

10. The motor terminal box shall be firmly bolted to the motor frame at four points. The terminal box shall be sized to meet the NEMA standards.
11. The terminal box shall be drilled and tapped to receive one compression watertight fitting to accommodate the appropriate electrical service cables.
12. Complete internal rotating assembly and stator winding shall be epoxy coated to maximize corrosion protection of electrical components.
13. The motor must be supplied with premium insulation for extended life in harsh environments.
14. The motor must use thrust bearings. Conrad-type bearings are not acceptable.

B. MOUNTING FLANGE

1. The mounting flange shall be 304 stainless steel.

C. SHAFT/UNIVERSAL JOINT COUPLING

1. The shaft shall be 304 stainless steel, full-welded to a forged carbon steel universal joint coupling. The shaft must be hollow to promote maximum airflow and oxygen transfer. Units with solid shafts are not acceptable. This shaft shall be dynamically balanced. Units that utilize vibration dampeners to control fatigue stress failures due to vibration are not acceptable.
2. The universal joint coupling shall include a standard grease fitting for maintenance lubrication. Units that utilize flexible couplings to attach the shaft to the motor are not acceptable.
3. The shaft shall be stabilized by a replaceable water lubricated bearing located within one inch from the propeller hub.
4. Units supplied with couplings that require alignment are not acceptable.
5. Any shafts requiring factory replacement to validate warranty requirements are not acceptable.

D. HOUSING

1. The housing shall be 304 stainless steel, non-corrosive, and flanged for mounting to the aerator. The housing shall form a guard around the hollow shaft and support a field replaceable, water-lubricated bearing, press-fitted into the housing lower end. Water lubrication holes shall penetrate the housing in the area surrounding the bearing.

E. BEARING

1. The aerator shall be supplied with a field replaceable water lubricated lower support bearing. The bearing shall be constructed of an appropriate material for the application inside a fiber backing. The bearing shall be press-fitted into the housing to allow ease of replacement.
2. Units utilizing a cantilever design without a lower support bearing or regreasable tapered roller bearings are not allowed.
3. Bearings requiring factory replacement to validate warranty requirements are not

acceptable.

F. SLEEVE

1. The replaceable zirconia sleeve shall be the only moving part in contact with the bearing and shall spin with the shaft as one unit. The sleeve shall be solid and homogeneous.

G. PROPELLER

1. The propeller shall be 304 stainless steel specifically designed to maximize oxygen transfer and mixing characteristics. Propellers shall be self-tightening such that the propeller threads tighten on the shaft threads during normal operation. The entire flow of aspirated air shall pass through the propeller via the hollow drive shaft along the axis of the propeller hub. Aluminum and standard marine type propellers are not acceptable.
2. The propeller design shall be tested in clean water and shown to draw a minimum of 85% of the recommended full motor amperage load at nameplate voltage and power factor.
3. The propeller shall be designed to allow easy removal in the field.

H. DIFFUSER

1. Aerator shall be equipped with a 304 stainless steel, self-tightening, diffuser threaded to the drive shaft. The aspirated air shall flow through the diffuser in one direction parallel with the axis of the diffuser. The entire flow of aspirated air shall exit at the diffuser opening.

I. VORTEX SHIELD

1. A vortex shield shall be furnished with each unit to eliminate the formation of vortices, maximize shaft airflow, and prevent cavitation damage to the propeller during operation. Units without vortex shields are not acceptable.

J. FLOATATION

1. The aerator floatation assembly shall be constructed of molded low-density polyethylene with ultraviolet inhibitor, filled with urethane foam. The pontoon shape shall be designed with smooth, beveled edges to allow freezing into ice without breakage. The floatation assembly shall come with a 304 SS float support with SS mesh prop screen attached. Welded stainless steel floats will not be acceptable.

K. ELECTRICAL SERVICE CABLE

1. Cable shall be CSA/UL approved for severe environments, suitable for underwater service and one continuous length, no splices or factory splices allowed.
2. The cable shall be jacketed, flexible stranded cable with individually wrapped conductors rated SEO-WA or equal.
3. Power cable shall be installed with protection from anchoring cables, so that wear, rubbing and contact with other items are avoided.

PART 3 EXECUTION

- 3.1 INSTALLATION: All Work shall conform to the Drawings, the manufacturer's recommendations, and the

requirements of DIVISION 1.

- A. The Manufacturer shall provide recommendations on aerator placement, installation, and operation.
- B. Anchor cables and mooring hardware shall be stainless steel or galvanized.
- 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. The aerator Manufacturer, through its local representative shall provide service to verify the proper installation and supervise the start-up of the aerators. Operation and maintenance instructions shall be given to the Engineer/Owner through the use of illustrated material within the manual.

END OF SECTION

## SECTION 11309

### ULTRAVIOLET DISINFECTION UNIT

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. General: This specification defines an electric ultraviolet disinfection unit.
- B. Single Source: The ultraviolet disinfection unit 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

##### 1.3 REFERENCES

Not Used

##### 1.4 SUBMITTALS

- A. Submit shop drawings and product data with the Project Bid under provisions of Section 01300-Submittals.
- B. Submit locations of the nearest permanent service headquarters of the aerator and motor manufacturers.
- C. Submit descriptive literature, including a cross-sectional view of each aerator and motor combination, which indicates materials of construction, weights, principal dimensions and other important details.
- D. Submit operation and maintenance data under provisions of Section 01300-Submittals and Section 01700 - Contract Closeout.
- E. Record Drawings: Submit record drawing under provisions of Section 01700-Contract Closeout.
- F. Submit copy of warranty.

##### 1.5 QUALITY ASSURANCE

- A. All materials used shall be new, of high grade and of properties best suited to the Work required. The ultraviolet chamber shall be manufactured of Type 316 Stainless Steel.
- B. Manufacturer's Qualifications:
  - 1. 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 equipment when needed within 24 hour period.
  - b. Providing needed spare parts for the equipment within 48 hour period.

C. Coordination Responsibility:

1. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

1.6 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.

1.7 WARRANTY

- A. The Manufacturer shall supply a 1-year non-prorated factory warranty.
- B. All parts supplied by the Manufacturer must be warranted the same.
- C. Field replacement of the aerator components shall in no way effect the factory warranty.
- D. The warranty repairs must be done in accordance with the factory O & M manual.

PART 2 PRODUCTS

2.1 GENERAL

- A. The equipment shall be manufactured by Atlantic Ultraviolet Inc., or pre-approved equal.

Atlantic Ultraviolet Corporation  
375 Marcus Rd  
Hauppauge, NY 11788  
631-273-0200  
www.ultraviolet.com

- B. The equipment shall be capable of treating the effluent from the lagoon and intermittent sand filter to less than 206 colonies of *Escherichia coli* colonies per 100 milliliters of water, at a rate of 20 gallons per minute.
- C. Spare parts:
  1. Provide one replacement lamp
  2. Provide one master service kit

PART 3 EXECUTION

- 3.1 INSTALLATION: All Work shall conform to the Drawings, the manufacturer's recommendations, and the requirements of DIVISION 1.
- A. The Manufacturer shall provide recommendations on placement, installation, and operation.
  - B. Make all electrical and control connections, in accordance with DIVISION 16.
  - C. 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. The Manufacturer, through its local representative shall provide service to verify the proper installation and supervise the start-up of the aerators. Operation and maintenance instructions shall be given to the Engineer/Owner through the use of illustrated material within the manual.

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 240 volt (V), 60 Hertz (Hz), 1-phase, 3-wire.
  2. Installation of control panel, safety switches, outlets, lights 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.
- A. 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.
- 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 approval.
- 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:
  - 1. Copy of the Record Documents for this portion of the work.
  - 2. Copies of all circuit directories.
  - 3. Copies of all warranties and guarantees.
  - 4. Emergency instructions.
  - 5. Spare parts list.
  - 6. 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 the installation of the new disconnect panel with Citizens Electric. 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 75°C maximum conductor temperature in wet locations and 90°C 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, 90°C 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 milliamperere 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.

2. Switches:

- a. Provide all one-, three-, and four-way switches as indicated on the drawings.
- b. Heavy duty toggles (snap action).
- c. Rated 20A, 120/277V, NEMA WD-1 specification grade complying with UL Standard 20 and Federal Specification WC-896.
- d. All exposed area shall be Grey.
- e. Provide Stainless steel cover plate for flush-mounted switches, single plate for gangs and matching countersunk screw. Wall plates for the following switches shall have engraved labels:
- f. Provide unit with screw-type terminals; back and side wired.
- g. Unit shall be mounted in boxes single or multiple gang.
- h. Provide unit with green hexhead grounding screw.
- i. Equipped with mounting yoke insulated from the switching mechanism.
- j. Weatherproof switches shall be supplied with a die cast aluminum, spring held cover with a rubber, watertight gasket
- k. Manufacturers: Hubbell; Leviton; Sierra-Electric

E. 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

F. 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.

G. 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.

- 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>240/120 Volt</u>
Phase A	Black
Phase B	Red
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 180° 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

### 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 11308 – Aerator  
B. Section 11309 - UV  
C. 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. Operation shall be by an on-off switch for each aerator.

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.

- 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%

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 CONTROL PANEL

- A. Panel 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.
- 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 coating 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 1/2" 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 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, 105°C, 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. Motor 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. 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 is energized) and have an adjustment knob for field adjustment of time delay.
  3. All control relays shall have an indicator light and check button.
- K. Timer Switch
1. Timer switch shall have capacity to set on time and duration.
  2. Timer settings shall be adjustable for up to 24 hours.
  3. Contacts shall be rated 5 amps.
- L. 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 mixer for "Run".
    - 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.
- M. 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.
- N. 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.
- O. 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.

- P. 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.
- Q. 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.
- R. All equipment and devices shall be rated for operation in an ambient temperature of 50°C, minimum.

### 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.

### 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. Fruitland Rest Area Panel: 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. Lightning arrestor.

5. Circuit breaker and motor contactor for each motor.
6. Elapsed time meters for each motor.
7. Switches, indicating lights, and fuse holders as indicated on the elevation view of panel deadfront.

**END OF SECTION**

APPENDIX A  
SLUDGE TESTING RESULTS

**ENGINEERING SURVEYS AND SERVICES  
TESTING LABORATORIES**

1113 Fay Street \* Columbia, Missouri 65201 \* (573) 449-2646  
802 El Dorado Drive \* Jefferson City, Missouri 65101 \* (573) 636-3303  
1775 West Main Street \* Sedalia, Missouri 65301 \* (660) 826-8618

RECEIVED

MAY 10 2012

MACON SKW  
MACON OFFICE

Date: 7 May 2012

Lab Number: L2807

Project: MODOT I55 Rest Area

Location: Fruitland, Missouri

Date Received: 11 April 2012

Sample No./  
Description: 3825 / Fruit land lagoon Sludge, 7 Apr 12

**TEST RESULTS**

Parameter	Units	3825	Method
Ammonia	mg/kg	435	4500NH3B C
Arsenic	mg/kg	1.9	6020
Cadmium	mg/kg	<0.5	6020
Chromium	mg/kg	8.8	6020
Copper	mg/kg	8.2	6020
Kjeldahl Nitrogen	mg/kg	6,340	4500-Norg
Lead	mg/kg	9.0	6020
Mercury	mg/kg	<0.3	3112 B
Molybdenum	mg/kg	<10.0	6020
Nickel	mg/kg	8.9	6020
Nitrate Nitrogen	mg/kg	3.8	SM16-418D
Phosphorous, Total	mg/kg	4,540	4500-P, B, E
Potassium	mg/kg	530	6020
Selenium	mg/kg	0.8	6020

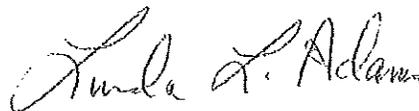
Sample secured and delivered to laboratory by others. ND = None Detected

Dry Weight Basis

Method number from "Standard Methods for the Examination of Water & Wastewater", current edition, unless noted otherwise.

cc: 1 Phillip Wilson

ENGINEERING SURVEYS AND SERVICES  
BY:



Linda L. Adams

**ENGINEERING SURVEYS AND SERVICES  
TESTING LABORATORIES**

1113 Fay Street \* Columbia, Missouri 65201 \* (573) 449-2646  
802 El Dorado Drive \* Jefferson City, Missouri 65101 \* (573) 638-3303  
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Date: 7 May 2012  
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Location: Fruitland, Missouri Date Received: 11 April 2012

Sample No./ Description: 3825 / Fruit land lagoon sludge, 7 Apr 12  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**TEST RESULTS**

Parameter	Units	3825	Method
Total Solids	%	15.4	2540 B
Zinc	mg/kg	24.2	6020
Digestion		Yes	

Sample secured and delivered to laboratory by others. ND = None Detected

Dry Weight Basis

Method number from "Standard Methods for the Examination of Water & Wastewater", current edition, unless noted otherwise.

cc: 1 Philip Wilson

ENGINEERING SURVEYS AND SERVICES  
BY:

  
Linda L. Adams

Cape Girardeau County  
MoDot I-55 Rest Area, Fruitland

STATE OF MISSOURI  
DEPARTMENT OF NATURAL RESOURCES

Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

[www.dnr.mo.gov](http://www.dnr.mo.gov)

May 03, 2012

Missouri Department of Transportation – Paul Huskey  
PO Box 160  
Sikeston, MO 63801

Dear Sir(s):

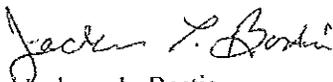
Plans and Specifications prepared by Shafer, Kline, and Warren, Inc for construction to serve MoDot I-55 Rest Area, Fruitland located in Cape Girardeau County, Missouri have been received by the Missouri Department of Natural Resources (MDNR). This submission, which included all the required documents, has been reviewed by staff at the Southeast Regional Office, and has been found to be in conformance with the Missouri Clean Water Law. Construction Permit No. CP0001286 is hereby issued. This permit authorizes construction of the facilities described on the permit. Approval of the MDNR must be obtained prior to making any changes from the approved plans and specifications. Please see page 2 for issuance and expiration dates. This permit may be extended one year upon written request to MDNR before the expiration date. Following completion of construction, the enclosed application must be completed and returned to MDNR.

If you were affected by this decision, you may appeal to have the matter heard by the administrative hearing commission. To appeal, you must file a petition with the administrative hearing commission within thirty days after the date this decision was mailed or the date it was delivered, whichever date was earlier. If any such petition is sent by registered mail or certified mail, it will be deemed filed on the date it is mailed; if it is sent by any method other than registered mail or certified mail, it will be deemed filed on the date it is received by the administrative hearing commission."

If one or more acres of land are disturbed over the life of this project, a permit for the discharge of storm water from all of the disturbed land (including individual house sites) may be required. Details are provided in storm water regulation 10 CSR 20-6.200.

For more information about these requirements or to obtain the application forms, please contact Mike Hefner, Southeast Regional Office at (573) 840-9750. Other environmental permits may also be required depending on the scope of the project. Please contact this office or the appropriate MDNR program to obtain information on other permits.

Sincerely,  
SOUTHEAST REGIONAL OFFICE

  
Jackson L. Bostic  
Regional Director

JLB/ds/mhk

Enclosure



c: Dennis E. Stith, P.E., Shafer, Kline & Warren, Inc., 3200 Penn Terrace, Suite 100, Columbia, MO 65202

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION



CONSTRUCTION PERMIT

The Missouri Department of Natural Resources hereby issues a permit to:

Missouri Department of Transportation – Paul Huskey  
PO Box 160  
Sikeston, MO 63801

for the construction of (described facilities):

This construction is for installation of aerators in the primary cell, removal of existing sand filter media, dosing pumps to a rehabilitated sand filter in the third cell, and ultraviolet disinfection equipment complete with all the necessary appurtenances to make a complete and usable system to serve MoDot, I-55 Rest Area (Fruitland) located near Fruitland, Missouri. All construction shall adhere to plans and specifications prepared by Shafer, Kline, and Warren, Inc., received on March 5, 2012 and subsequent revisions April 30, 2012.

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Construction of such proposed facilities shall be in accordance with the provisions of the Missouri Clean Water Law, Chapter 644, RSMo, and regulation promulgated thereunder, or this permit may be revoked by the Department of Natural Resources.

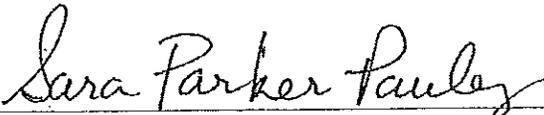
As the Department of Natural Resources does not examine structural features of design or the efficiency of mechanical equipment, the issuance of this permit does not include approval of these features.

A representative of the department may inspect the work covered by this permit during construction. Issuance of a permit to operate by the department will be contingent on the work substantially adhering to the approved plans and specifications.

This permit applies only to the construction of water pollution control components; it does not apply to other environmentally regulated areas.

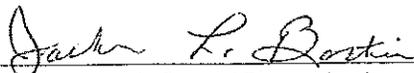
05/03/2012

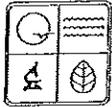
Effective Date

  
Sara Parker Pauley, Director, Department of Natural Resources

05/02/2013

Expiration Date

  
Jackson L. Bostie, Regional Director, Southeast Regional Office



MISSOURI DEPARTMENT OF NATURAL RESOURCES  
WATER PROTECTION PROGRAM  
STATEMENT OF WORK COMPLETED

1. PROJECT INFORMATION			
CONSTRUCTION PERMIT #		DEPARTMENT FUNDED PROJECT #	
NAME OF THE PROJECT			
LOCATION OF THE PROJECT			
BRIEF DESCRIPTION OF THE PROJECT			
2. AS BUILTS			
<input type="checkbox"/> An electronic copy of the as built are required and included with this application.			
3. PROJECT OWNER			
NAME		TELEPHONE NUMBER WITH AREA CODE	
ADDRESS	CITY	STATE	ZIP CODE
4. CONTRACTOR COMPANY			
CONTRACT NUMBER			
NAME		TELEPHONE NUMBER WITH AREA CODE	
ADDRESS	CITY	STATE	ZIP CODE
5. INSPECTIONS CONDUCTED BY CONSULTANT			
DATES OF CONSTRUCTION INSPECTIONS DURING CONSTRUCTION			
DATE OF FINAL INSPECTION			
6. ADDENDA APPROVAL			
ISSUED ADDENDUM #		DEPARTMENT APPROVAL DATE	

**7. CHANGE ORDER APPROVAL**

EXECUTED CHANGE ORDER #	DEPARTMENT APPROVAL DATE

**8. CONSULTANT:** I hereby affirm, to the best of my knowledge and belief, based on inspections, observations, testing of the construction and upon reports submitted by others, that this project is complete. The construction was completed in accordance with the approved plans and specifications and the above listed and approved Addenda and Change Order(s).

SIGNATURE			
PRINT NAME		DATE	
CONSULTING FIRM NAME		LICENSE #	
ADDRESS	CITY	STATE	ZIP CODE
NAME OF THE PROJECT		TELEPHONE NUMBER WITH AREA CODE	

Mail completed copy to: MISSOURI DEPARTMENT OF NATURAL RESOURCES  
 WATER PROTECTION PROGRAM  
 P.O. BOX 176  
 JEFFERSON CITY, MO 65102-0176

## PERMIT CONDITIONS

The owners or operators of sanitary sewer systems or extensions for which construction permits were issued shall apply for a letter of authorization for operation, in accordance with Department of Natural Resources Rule 10 CSR 20-6.010(B), certifying that the collection sewers have been built in accordance with the approved plans and specifications or with "as built" plans and specifications, submitted with the certification. The certification shall state that the "as built" plans and specifications conform to the requirements contained in 10 CSR 20-8.110 through 10 CSR 20-8.220 including the following important requirements for acceptance testing and protection of water supplies. The system or extension then shall be considered as a part of the treatment facility to which it is tributary for permit purposes.

1. In accordance with 10 CSR 20-8.120(6)(G) deflection tests shall be performed on all flexible pipe.
  - A. The test shall run not less than 30 days after final backfill has been placed. No pipe shall extend a deflection of 5%. If a rigid ball or mandrel is used, it shall have a diameter equal to 95% of the inside diameter of the pipe and mechanical pulling devices shall not be used.
2. In accordance with 10 CSR 20-8.120(6)(H) leakage tests, including water or low-pressure air testing, shall be specified. The testing method selected should take into consideration the range in groundwater elevations projected and the situation during the test.
  - A. The leakage outward or inward (exfiltration or infiltration) shall not exceed 200 gallons of water per inch of pipe diameter per mile per day or 0.19 cubic meters per centimeter of pipe diameter per kilometer per day for any section of the system. A test shall be performed with a minimum positive head of 2 feet or .61 meters. For the purpose of leakage tests, manholes shall be considered pipe of equivalent diameter and shall be tested by an appropriate test method.
  - B. The low-pressure air test shall conform to the testing procedures described in ASTM F1417-92, entitled *Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air*.
3. In accordance with 10 CSR 20-8.120(11) there shall be no physical connections between a public or private potable water supply system and a sewer or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.
  - A. Sewers in relation to water works structures shall meet the requirements of 10 CSR 60-2.010 with respect to minimum distances from public water supply wells or other water supply sources and structures.
  - B. Sewer mains shall be at least 10 feet or 3 meters horizontally from any existing or proposed water main. The distances shall be measured edge-to-edge. In case where it is not practical to maintain a 10 separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer and provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer at an elevation that the bottom of the water main is at least 18 inches or 46 centimeters above the top of the sewer.
  - C. Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches or 46 centimeters between the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. When a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
  - D. When it is impossible to obtain proper horizontal and vertical separation, the sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure watertightness prior to backfilling.