MoDOT

MoDOT MAINTENANCE FACILITY SEWER
VERSAILLES, MISSOURI

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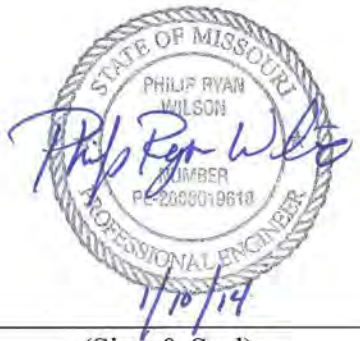

(Sign & Seal)

TECHNICAL SPECIFICATIONS

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SECTION 01000

GENERAL REQUIREMENTS

1. GENERAL:

1.1. Scope of project: The project consists of the construction of approximately 1,200 feet of 6" SDR 26 PVC and 260 feet of 4" SDR 26 PVC gravity service pipe with 2 – 4' diameter manholes, 4 double cleanouts, and 2 cleanouts. The project will also consist of a 70' railroad bore using 10" steel casing and will also have three service taps. Finally there will be the abandonment of an existing septic tank in place.

1.2. Objective of contract: It is the objective of this contract to provide the Owner with a complete and fully functional wastewater treatment system. The facilities furnished and the construction performed must conform to this objective. These specifications and drawings present those minimum standards considered essential. In no respect are these requirements intended to alleviate the Contractor's responsibility in achieving this objective.

1.3. Workmanship and materials: All work or materials commonly known to be required by best modern practice for any or all portions of the project shall be included in the Contractor's obligation whether or not shown on drawings or called for in these specifications.

2. DRAWINGS:

2.1. Detailed drawings: The detailed drawings for this contract are identified as follows:

DRAWING NO.	TITLE
1	Cover Sheet
2-3	Gravity Sewer Plan & Profile
4	Erosion Control Plan
5	Misc. Details
6	Erosion Control Details

2.2. Working Drawings: The Contractor, his subcontractors and suppliers shall be furnished with up to a total of 5 sets of drawings and specifications without charge. Additional sets of drawings and specifications shall be furnished to the Contractor at a cost of $5.00 per drawing sheet and $50.00 per set of specifications.

3. OTHER CONTRACTS: No other Contractors will be working as part of this project.

4. LABORATORY TESTS: Routine shop or factory tests, field testing and

geotechnical-soils testing shall be paid for by the Contractor. Refer to Sections 02220, 03100 for laboratory and testing requirements concerning backfill and concrete materials. Costs for testing shall be incidental to other items at work.

5. CONSTRUCTION CONDITIONS: The proposed work is in the City of Versailles, Missouri and Morgan County.

6. EXISTING UTILITIES AND IMPROVEMENTS: The size, type and location of all known obstacles on the property of the proposed construction are shown on the drawings. The 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.

7. PROTECTION OF EXISTING PROPERTY AND EXISTING IMPROVEMENTS: The Contractor shall not use any of the Owner's facilities or equipment for personal comfort, for execution of the work or for any other purpose. The Contractor shall provide all of his own tools, devices, sanitary facilities and personnel facilities.

7.1 The Contractor shall protect from damage or injury all existing property and improvements. Any such items which are damaged shall immediately be repaired or replaced at the Contractor's expense. Gas mains, water mains, sanitary and storm sewers, telephone and electric power conduit and cables, house drains and services shall be exposed in advance of excavation so that they might be protected against damage and so that minor change in grade and alignment may be made, if necessary, or so that the obstruction may be removed and relocated as directed by the Owner.

7.2 If the Contractor desires the removal of an existing improvement such as a pipe, sewer, conduit, cable, pole, tree, shrub, curb, pavement, etc., to facilitate construction, such item not conflicting with the final location of the project, he shall apply to the Owner for permission for such temporary removal with the expressed understanding that, if such permission is granted, all costs incurred in removing and replacing the item shall be paid by the Contractor and that no extra compensation shall be paid the Contractor for work done by him in the removal and replacement of the item.

8. MAINTENANCE OF TRAFFIC: The Contractor shall conduct his work so as to interfere as little as possible with public traffic, whether vehicular or pedestrian. Whenever it is necessary to cross or interfere with roads, driveways and walks, whether public or private, the Contractor shall at his own expense provide and maintain suitable and safe bridges, detours, or other temporary passage for the accommodations of public and private travel, and shall give reasonable notice to

owners of private drives before interfering with them.

9. BARRICADES AND WARNING SIGNS: To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, flashers and watchmen shall be placed and maintained during the progress of the construction work. Rules and regulations of governmental authorities regarding safety provisions shall be observed.

10. DRAINS: Adequate provision shall be made for the flow of sewers, drains and water courses encountered during construction. Any structures which are disturbed shall be satisfactorily restored upon completion of the work.

11. REMOVING AND REPLACING PAVING: The Contractor shall remove and replace all street or roadway paving, driveways, surfaced parking areas and other surfaced or graveled areas disturbed or damaged during construction. It shall be the responsibility of the Contractor to determine for himself the nature and thickness of all paving to be cut and replaced. All pavement cuts shall be made with a concrete saw and shall be smooth and straight. Streets which, in the opinion of the Owner, must be reopened at the earliest possible time to traffic shall be backfilled and the pavement restored immediately after the pipe and fittings are laid. All materials and workmanship used shall be of equal quality to the materials and workmanship used in the original construction of the surface and shall be subject to the approval of the Owner.

12. UTILITY FACILITIES:

12.1. Sanitary facilities: The Contractor shall provide and enforce the use of enclosed, non-discharging sanitary conveniences at the site of the work.

12.2. Water: Any water required for construction or testing shall be purchased from the Owner under the Owner's standard conditions. The Contractor shall not operate any existing hydrants or valves without the Owner's permission.

12.3 Electric: Any electric energy required for construction shall be purchased from the Owner under the Owner's standard conditions.

13. DELIVERY OF MATERIAL: The Contractor shall have someone available to receive all material and equipment delivered to the site of the work under this contract.

14. CLEANING UP: As directed by the Owner during construction and at the completion of the project, the Contractor shall remove from the Owner's property and from all public and private property, at his own expense, all temporary structures, rubbish and waste material resulting from his operations. At the

Completion of the project the Contractor shall restore all areas used for construction office, parking, equipment and material laydown or equipment and material storage to their original condition.

15. CONSTRUCTION AND PAYMENT SCHEDULES: The Owner desires to have this contract complete and capable of full operation within the time specified in the bid. In preparing his bid, the Contractor should anticipate this schedule. The construction sequence shall be at the option of the Contractor so long as it meets the conditions specified herein and the Owner's approval. The Contractor shall submit to the Owner, within ten days after the execution of the Contract or no later than the time of the preconstruction conference, an estimated progress schedule indicating the starting and completion dates of the various stages of the work and a monthly schedule of estimated payments. The schedule of estimated payments must be updated at any time there is a variation of more than 10 percent.

16. THIS SECTION DELETED.

17. DISPOSAL OF MATERIALS: Burning of refuse or debris will not be permitted. All refuse, debris, excess excavation, material unsuitable for backfill, etc., shall be disposed of via means and at a site obtained by the Contractor and approved by the Owner.

18. EASEMENTS AND RIGHT-OF-WAY: The Owner has obtained or is in the process of obtaining permanent and temporary easements as indicated on the drawings. Requirements or conditions of existing easement agreements obtained by the Owner are indicated on the drawings or in these specifications and are a part of this contract unless specifically stated otherwise. Should the Contractor desire easements for construction or access in addition to those acquired by the Owner, the Contractor shall obtain these additional easements, at no additional cost to the Owner.

19. SEPARATION OF WATER AND SEWER UTILITIES

19.1 General: The following factors should be considered in providing adequate separation:

1. Materials and type of joints for water and sewer pipes
2. Soil conditions
3. Service and branch connections into the water main and sewer line
4. Compensating variations in the horizontal and vertical separations
5. Space for repair and alterations of water and sewer pipes; and
6. Off-setting of water mains around manholes.

19.2 Parallel Installation: Water mains shall be laid at least ten feet horizontally from

any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the Department of Natural Resources may allow deviation on a case-by case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer and in either case, at such an elevation that the bottom of the water main is at least 18 inches above the sewer. In areas where the recommended separations cannot be obtained, either the waterline or the sewer line shall be constructed of mechanical joint pipe or cased in a continuous casing.

19.3 Crossings: Water mains crossing sewers shall be laid to provide a minimum vertical clear distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. At crossings, the full length of water pipe shall be located so both joints will be as far from the sewer as possible but in no case less than ten feet. Special structural support for the water and sewer pipes may be required. In area where the recommended separations cannot be obtained either the waterline or the sewerline shall be constructed of mechanical joint pipe or cased in a continuous casing that extends no less than ten feet on both sides of the crossing.

19.4 Exception: Any variance from the specified separation distances in paragraphs B and C must be submitted to the Department of Natural Resources for approval.

19.5 Force Mains: There shall be at least a ten-foot horizontal separation between water mains and sanitary sewer force mains and they shall be in separate trenches. In areas where these separations cannot be obtained, either the waterline or the sewer line shall be cased in a continuous casing.

19.6 Sewer Manholes: No waterline shall be located closer than ten feet to any part of a sanitary or combined sewer manhole.

19.7 Disposal Facilities: No waterline shall be located closer than 25 feet to any on-site wastewater disposal facility, agricultural waste disposal facility, or landfill.

20. STARTUP: Not Used.

21. MONTHLY PROGRESS MEETINGS: Monthly progress meetings shall be held between the Contractor, Owner and Engineer. The dates for each meeting will be set at the preconstruction conference.

22. SATURDAY, SUNDAY, HOLIDAY AND NIGHT WORK: No work shall be done on Saturday, Sunday, legal holidays, or at night, without the approval of the Owner in each case, except such work as may be necessary for mandatory completion dates

or for the proper care, maintenance and protection of work already done or of equipment and public property covered by the Contract. Approval of the Owner shall be sought at least forth-eight (48) hours in advance of such work whenever practicable.

23. LAND DISTURBANCE: Not Used.

24. SUBMITTALS:

24.1 Shop Drawings: The Contractor shall submit for approval a preliminary schedule of Shop Drawing submittals within ten days after the execution of the Contract or no later than the time of the preconstruction conference. The Contractor shall submit for approval the items required by the respective Technical Specification Divisions in accordance with the General Conditions.

24.2 Construction and Payment Schedules: The Contractor shall submit for approval a Construction Schedule and a Schedule of Estimated Payments within ten days after the execution of the Contract or no later than the time of the preconstruction conference.

24.3 Photographic Record: The Contractor shall submit a video tape and photographic record of the work area within 10 days after execution of the contract, or no later than the pre-construction meeting. This record will show the condition of the work area prior to any construction work beginning.

25. Construction Staking: The Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pipe locations and other working points, lines, elevations and cut sheets.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Proposed Products list.

C. Product Data.

D. Shop Drawings.

E. Certificates.

F. Manufacturer's instructions.

G. Preconstruction photographs.

1.2 RELATED SECTIONS

A. Section 01300 - Submittals:

B. Section 01400 - Quality Control:

C. Section 01700 - Contract Closeout: Contract 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 Engineer acceptance form.

B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

D. 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.

E. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.

F. For each submittal for review, allow 15 days excluding delivery time to and from the contractor.

G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

H. Provide space for Contractor and Engineer review stamps.

I. When revised for re-submission, identify all changes made since previous submission.

J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.

K. Submittals not requested will not be recognized or processed.

1.5 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.

1.6 PRODUCT DATA

A. Product Data For Review:
   1. Submitted to 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 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 three copies which will be retained by the 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. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

G. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 - CONTRACT CLOSEOUT.

1.7 SHOP DRAWINGS

A. Shop Drawings For Review:
   1. Submitted to 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 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. Submit the number of opaque reproductions which Contractor requires, plus three copies which will be retained by Engineer.

1.8 CERTIFICATES

A. When specified in individual specification sections, submit certification by the manufacturer, installation/application subcontractor, or the Contractor to 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 Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to 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.

1.10 PRECONSTRUCTION PHOTOGRAPHS

A. Two prints, 3"x 5", Color, mounted on 8½”x 11" album, labeled with area included in photograph and a video tape of a walk through along the alignment of the proposed sewer mains.

B. Take adequate photos of all features prior to start of construction in each area.

C. Identify photos with date, orientation, and project identification.

D. Payment for photos is incidental to other items of work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 REQUIRED SUBMITTALS

A. Contractor shall submit the following information for materials and equipment to be provided under this contract.

B. Legend:

CODE	TYPE OF SUBMITTAL
1	Shop Drawings
2	Product Data
3	Sample
4	Certifications
5	Manufacturer's Instructions
6	Test Report
7	Inspection Report
8	Wiring Diagram
9	Record Photographs
10	Maintenance Data
11	Operating Instructions
12	Warranty

C. List of required submittals:

SECTION	DESCRIPTION	CODE
01000	General Requirements	9
02730	Sewage Piping Systems	2, 4, 5
02738	Manholes and Covers	1, 2, 4, 5
02922	Seeding	2, 4
03100	Concrete Form Work	1, 2
03200	Concrete Reinforcement	1, 2, 4, 6
03300	Cast-In-Place Concrete	2, 4, 6

END OF SECTION

SECTION 01400

QUALITY CONTROL

1PART GENERAL

1.1 SECTION INCLUDES

A. Quality assurance - control of installation.

B. References and standards.

C. Tolerances

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.

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 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 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, except where a specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

2PART PRODUCTS
Not Used.

PART 3 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.

C. Examine and verify specific conditions described in individual specification sections.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1PART GENERAL

1.1 SECTION INCLUDES

A. Temporary Sanitary Facilities.

B. Barriers

C. Protection of Work.

D Progress Cleaning & Waste Removal

E. Removal of Utilities

1.2 TEMPORARY SANITARY FACILITIES

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

1.3 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas specifically any areas that present a potential hazard to the general public, to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

1.4 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.

1.5 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site at an approved facility.

1.6 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

2PART PRODUCTS

Not Used.

3PART EXECUTION

Not Used.

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. 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.

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. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.

F. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

G. 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.

B. Products Specified by Naming One or More Manufacturers where Substitutions are not Prohibited: Submit a request for substitution for any manufacturer not named, in accordance with the following article.

1.7 SUBSTITUTIONS

A. 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 which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner Engineer 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 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 01700

CONTRACT CLOSEOUT

1PART GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Final cleaning.

C. Adjusting.

D. Project record documents.

1.2 RELATED SECTIONS

A. Section 01500 - Construction Facilities and Temporary Controls: Progress cleaning.

1.3 CLOSEOUT PROCEDURES

A. Contractor to notify Owner and Engineer for scheduling of a Pre-Final Inspection.

B. 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 Engineer's review.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.4 ACCEPTANCE OF FINAL PAYMENT AS RELEASE

The acceptance by the Contractor of final payment shall be and shall operate as a release to the Owner of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the contractor for all things done or furnished in connection with this work. Any payment, however final or otherwise, shall not release the Contractor or its sureties from any obligations under the Contact Documents or the Performance and Payment Bonds.

1.5 WARRANTY OF WORK

The contractor shall warrant all materials and equipment furnished and work performed for a period of one (1) year from the date of completion and acceptance of the work. The contractor warrants and guarantees for a period of one (1) year from the date of completion and acceptance of the work that the completed work is free from all defects due to faulty materials or workmanship and the CONTRACTOR shall promptly make such corrections as may be necessary by reason of such defects including the repairs of any other damages that were caused by defects in the work. The owner will give notice of observed defects with reasonable promptness. In the event that the contractor should fail to make such repairs, adjustments, or other work that may be necessary by such defects, the owner may do so and charge the contractor the cost hereby incurred. In emergency where, in the judgement of the owner, delay would cause serious loss or damage, repairs and replacement of defects in the work and damage caused by the defects may be made without notice being sent to the contractor, and the contractor shall pay the cost thereof. The Performance Bond shall remain in full force and effect through the warranty period.

1.6 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean sites, remove waste and surplus materials, rubbish, and construction facilities from the sites.

1.7 ADJUSTING

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

1.8 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer’s instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. 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.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Details not on original Contract drawings.

G. Submit documents to Engineer with claim for final Application for Payment.
   1. Contractor shall record and submit to Engineer with final payment application records of all service connections.
   2. Contractor will be responsible for providing the “as-built” drawings.

2PART PRODUCTS

Not Used.

3PART EXECUTION

Not Used.

END OF SECTION

SECTION 02205

TEMPORARY EROSION & SEDIMENT CONTROL

1. GENERAL:

The Contractor shall furnish all labor, material, equipment, and service necessary to construct, maintain, and remove the erosion control measures as shown on the drawings and specified herein.

2. STRAW BALE BARRIER:

2.1 Description:

Bales of straw placed and secured in a row to intercept and detain sediment.

2.2 Construction:

Bales shall be placed in a single row, lengthwise and embedded in the soil in a depth of 3 inches. Bales must be securely anchored in place by stakes or re-bars driven through the bales or by other acceptable means to prevent displacement. Any damage to barrier must be repaired promptly as needed.

3. SILT FENCE:

3.1 Description:

Geotextile Filter Fabric buried at the bottom, stretched, and supported by posts to intercept and detain sediment.

3.2 Materials:

3.2.1 Geotextile Fabric:

Fibers used in the manufacture of geotextiles shall consist of longchain synthetic polymers, composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. They shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including selvages. The geotextile shall be free of any treatment or coating which might adversely alter its physical properties after installation. Unless otherwise specified, geotextile shall be furnished in 36 inch width rolls.

3.2.2 Protection:

Geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement. Each roll shall be labeled or tagged to provide product identification sufficient for inventory and quality control purposes. Rolls shall be stored in a manner which protects them from the elements.

3.2.3 Posts:

Either wood, steel, or synthetic posts may be used. Posts shall have a minimum length of 48 inches plus embedment depth and be of sufficient strength to resist damage during installation and to support applied loads.

3.2.4 Support Fence:

Wire or other support fence shall be at least 24 inches high and strong enough to support applied loads.

3.2.5 Prefabricated Fence:

Prefabricated fence systems may be used provided they meet all of the above material requirements.

3.3 Certification and Sampling:

The contractor shall furnish a manufacturer's certification, in triplicate, stating that the material supplied conforms to the requirements of these specifications. The certification shall include or have attached, typical results of tests for the specified properties, representative of the materials supplied. The engineer reserves the right to sample and test any material offered for use. Acceptance will be based on the certification and the results of any tests the engineer may perform.

3.4 Construction Requirements:

3.4.1 General:

The contractor shall install a temporary silt fence as shown on the plans, and at other locations as directed by the engineer. Fence construction shall be adequate to handle the stress from hydraulic and sediment loading. Geotextile at the bottom of the fence shall be buried as indicated on the standard drawings. The trench shall be backfilled and the soil compacted over the geotextile. The geotextile shall be spliced together as indicated on the standard drawings.

3.4.2 Post Spacing:

Post spacing shall not exceed 8 feet for wire support fence installations or 5 feet for self-supported installations. Posts shall be driven a minimum of 24 inches into the ground. Where rock is encountered posts shall be installed in a manner approved by the engineer. Closer spacing, greater embedment depth and/or wider posts shall be used as necessary in low areas and soft or swampy ground to ensure adequate resistance to applied loads.

3.4.3 Fencing:

When support fence is used, the mesh shall be fastened securely to the up-slope side of the post. The mesh shall extend into the trench a minimum of 2 inches and extend a maximum of 36 inches above the original ground surface. When self-supported fence is used, the geotextile shall be securely fastened to fence posts.

3.4.4 Maintenance:

It is the contractor's responsibility to maintain the integrity of silt fences as long as they are necessary to contain sediment runoff. The contractor shall inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Any deficiencies shall be immediately corrected by the contractor. In addition, the contractor shall make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, additional silt fences shall be installed as approved or directed by the engineer. The contractor shall remove and dispose of sediment deposits when the deposit approaches one-half the height of the fence or sooner when directed by the engineer. If required by heavy sediment loading, a second silt fence shall be installed as directed by the engineer.

3.4.5 Removal:

The silt fence shall remain in place until the engineer directs that it be removed. Upon removal, the contractor shall remove and dispose of any excess silt accumulations, grade and dress the area to the satisfaction of the engineer, and establish vegetation on all bare areas in accordance with the contract requirements.

3.4.6 Physical Requirements for Temporary Silt Fence Geotextiles:

Physical requirements shall conform to the following table:

Property	Test Method	Wire Fence Supported Requirements	Self Supported Requirements
Tensile Strength, Lbs.	ASTM D4632	90 Minimum[2]	90 Minimum[2]
Elongation at 50% Minimum tensile strength. (45 Lbs.)	ASTM D4632	N/A	50 Maximum
Filtering Efficiency, %	VTM-51[3]	75	75
Flow Rate, gal/ft^2/min	VTM-51[3]	0.3	0.3
Ultraviolet Degradation at 500 hrs.	ASTM D 4355	Minimum 70% Strength Retained	Minimum 70% Strength Retained

Note:

1. All numerical values represent minimum average roll value.
2. When tested in any principal direction.
3. Virginia DOT test method.

4. SUBMITTALS:

The Contractor shall submit for approval the following items required by this Section:

Geotextile Fabric

END OF SECTION

SECTION 02220

EARTHWORK AND TRENCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Disposal of materials.

2. Tree removal.

3. Site clearing and preparation.

4. Excavation.

5. Construction of fills and embankments.

6. Trenching.

7. Pipe embedment requirements and schedule.

8. Backfilling.

B. The Contractor shall perform investigations, before bidding, as he considers necessary to satisfy himself as to the materials to be encountered. He shall then submit his bid to include the removal of any and all material. The Contractor shall perform all excavation, embankment, trenching, backfilling, cushioning, surface dressing, dewatering, shoring, surface restoration and disposal of waste as required for site grading, structures, piping and appurtenances as shown on the drawings.

1.2 RELATED SECTIONS

A. Section 02730 - Sewage Piping Systems

B. Section 02920 - Lawns and Grasses

1.3 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 (75µm) 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.

5. ASTM D-4318 Standard Test Methods for Liquid Limit, Plastic Limit, & Plasticity Index of Soils

6. Midwest Concrete Industry Board (MCIB) Standard Specification for Concrete Work.

1.4 SUBMITTALS

A. The Contractor shall submit the following items, in accordance with Section 1300:

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

1.5 DEFINITIONS

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

B. Pipe embedment: Pipe embedment is defined as soil or stone aggregate material placed under, around, and in some cases over the pipe. The material type and extent of embedment is specified 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. Structure backfill: Structure backfill is defined as soil or stone aggregate material placed around or above subsurface structures, such as manholes, vaults, foundations, and wetwells, to replace excavated material below existing grade.

1.6 MAINTENANCE OF WORK: The Contractor shall be responsible for the satisfactory compaction and maintenance of all completed excavation, embankment, and backfill. If, prior to the expiration of the General Guaranty period stipulated in the 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.

PART 2 PRODUCTS

2.1 GENERAL

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

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

2.2 PIPE EMBEDMENT MATERIAL

A. Granular Embedment Material: Embedment material shall be a ¾" crushed stone with at least 95% of the material passing the ¾" square sieve and no more than 5% passing a # 4 sieve.

2.2a PIPE EMBEDMENT MATERIAL FOR STORMWATER PIPING

A. Granular Embedment Material: Embedment material for installation in pipe trenches and other locations indicated on the drawings shall be crushed stone conforming to MCIB Standard Concrete Specifications Section 4 for coarse aggregate meeting the gradation specified under Column III, Table 2 for ½-inch aggregate with the modification that the maximum allowable percentage of material finer than No. 200 sieve shall be between 2.0% and 5% as determined by ASTM C-117. The gradation is repeated below for information:

Sieve Size	Percent Passing
3/4”	100
1/2”	90-100
3/8”	40-70
No. 4	0-15
No. 8	0-5

2.3 COMPACTED CRUSHED STONE: Crushed stone shall be as specified for pipe embedment material.

2.4 FILL MATERIALS

A. Bulk Fill Material: Bulk fill material for earthfills and embankments 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. Bulk fill material shall be imported if suitable soil material is not available on site.

B. Random Backfill Material: Random backfill material for pipe and utility trenches shall be job-excavated soil material which is free from organic material, debris, and rocks or lumps larger than 6 inches in their greatest dimension.

C. Select Fill Material: Select backfill material shall be a sorted, job-excavated or imported soil material as specified for bulk fill material, except no rocks, stones, or lumps larger than one inch in largest dimension shall be present.

C. Granular Backfill Material: 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	4 - 8

1. Granular backfill material shall be free from clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5.

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 $10x10^{-6}$ cm/sec.

B. Material shall be free of any stones, bricks, concrete, etc., except gravel or crushed rock of 3/4 inch size or less.

PART 3 EXECUTION

3.1 PREPARATION:

A. The Contractor shall verify that required lines, levels, contours and datum are as shown in the plans.

B. Grading, excavation and backfilling shall be made to the lines, grades and cross sections indicated in the plans.

C. The Contractor shall maintain the site and conduct earthwork operations to ensure that the property is well drained at all times. The Contractor shall protect adjacent and downstream properties from damage or pollution caused by erosion. The Contractor is responsible for erosion control measures and methods and shall conduct earthwork operations to ensure the protection of all downstream and adjacent properties. The Contractor shall implement any additional erosion control measures to prevent damage.

D. Existing Utilities:

1. The Contractor shall verify the location and depth of all utilities a minimum of 24 hours prior to construction. The Contractor may

utilize the toll free number for the "Missouri One Call System, 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.

2. Coordinate removal or relocation of existing utilities with their Owner.

3. Locate and identify utilities that remain and protect them from damage. The Contractor shall make every reasonable effort to protect all existing utilities from damage. If any utility is damaged through the carelessness or negligent actions of the Contractor, the utility shall be repaired by its owner at the Contractor's expense.

4. Abandoned pipes, which the drawings indicate shall be capped or filled, do not need to be removed. All other abandoned pipe conduit within the limits of grading shall be removed by the Contractor

E. Existing fences: Fences within the construction grading area shall be removed and reconstructed to equal or better quality than that of the fence removed. It shall be the sole responsibility of the Contractor to maintain all gates, fences, cattle guards and the like encountered during construction, as required to prevent the straying of pets and livestock.

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

3.3 SITE CLEARING:

A. 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 in accordance with the stipulations of Section 1000. 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.

B. Clearing and stripping: All vegetation and other unsuitable material, or other miscellaneous debris occurring within the limits of the excavation and site grading shall be removed as part of the clearing operations and disposed of by, and at the expense of, the Contractor. Likewise, six inches of topsoil

shall be stripped from the disturbed construction areas and stockpiled for later use in final grading.

C. Tree Removal: It is the intent of these specifications to minimize tree removal.

1. No trees except for those designated for removal on the drawings are to be damaged or removed without the express approval of the Owner.

1. All trees, brush, etc., shall be disposed of by the Contractor as specified herein.

2. 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.

3. 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.

3.4 EARTHFILLS AND EMBANKMENTS

A. Material and Compaction Requirements:

1. Fill areas which are below an envelope defined as being within 5 horizontal feet of a structure or concrete slab shall be filled with select backfill material, as specified herein, unless otherwise indicated on the Drawings. The select backfill material shall be placed in lifts not exceeding 8 inches loose thickness, and shall be compacted to a minimum 95 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 2 or minus 2 percent of optimum.

2. Fill areas which are outside the envelope described above shall be filled with bulk fill material, as specified herein, unless otherwise indicated on the Drawings. The bulk backfill material shall be placed in lifts not exceeding 8 inches loose thickness, and shall be compacted to a minimum 90 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 3 or minus 3 percent of optimum.

a) For areas which will be surfaced with gravel, the top two feet of bulk fill 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 2 or minus 2 percent of optimum.

B. All unstable or unsuitable material shall be removed from the existing surface to receive fill material prior to commencing embankment work.

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 or backfill 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 ensure uniform compaction.

H. No rocks or stones shall be placed in the upper 18 inches of any fill or embankment. Rocks or stones within the size limit may be incorporated in the remainder of fills and embankments, provided they are distributed so they do not interfere with proper compaction, as determined by the Engineer.

3.5 EXCAVATION

A. General:

1. Where necessary, satisfactory sheeting and bracing shall be used to hold the sides of the excavation at all points where damage might result from slides.

   a) All sheeting and bracing shall be removed as the backfill is placed, unless otherwise directed in writing by the Owner or shown on the drawings. All voids left or caused by the withdrawal of sheeting shall be filled immediately with suitable material and compacted.

2. Excavation below structure or trench subgrade:

   a) Over excavation due to Contractor's oversight shall be backfilled with granular embedment material placed in 8-inch loose lifts and compacted to 90 percent of the maximum density for that material in accordance with ASTM D-698, at no additional cost to the Owner.

   b) When unstable or unsuitable material is encountered in the 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 subgrade bottom is soft and in the opinion of the Engineer cannot support the foundation, a further depth and/or width shall be excavated and refilled to the desired pipe or foundation grade with granular embedment material as required by the Engineer to assure a firm foundation. 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 subgrade.

3. No blasting of any kind for rock excavation or for other purposes will be permitted unless permission is given in writing from the Owner.

4. Dewatering: Each excavation shall be kept dry by Contractor during

subgrade or pipe embedment preparation, and continually thereafter until the structure or pipe is completely installed, to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

a) All excavations for concrete structures or trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the groundwater level at least 12 inches below the bottom of the excavation.

b) Trenches shall be drained so that workmen do not have to work in mud or water. The discharge of pumps used for draining the trenches shall be led to natural drainage courses or drains.

B. Structure Excavation:

1. Excavation for structures shall be performed to the limits indicated on the Drawings.

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

2. Compacted crushed stone shall be placed beneath concrete slabs and in other locations indicated on the Drawings. Crushed stone shall be placed in 6" loose lifts and compacted to 90% of maximum dry density as determined by ASTM D-698, at a moisture content within plus or minus 3 percent of optimum.

C. Trenching:

1. All pipeline excavation shall be open cut unless shown otherwise on the plans. The Contractor shall not open more trench in advance of the pipe laying than is necessary. The length of open trenches shall be limited depending on the nature of the soil and safety considerations. All open trenches shall be adequately protected from collapse.

2. Trenches shall be excavated within the limits of public right-of-way or easements in conformance with the requirements herein. Trenches shall be excavated to the width and depth necessary to install sewer

pipe to the lines, grades and elevations shown on the drawings.

3. In those areas designated to be landscaped, seeded or sodded, the top soil shall be excavated, stockpiled and replaced as specified herein.

4. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One city block or 300 feet, whichever is the shorter, shall be the maximum allowable length of open trench ahead of pipe laying.

5. 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 (inches)	Min. Clearance on Each Side of Pipe (inches)	Maximum Trench Width (inches)
<4	20	6	26
4-6	22	6	30
8	22	6	30
10	24	6	32
12	27	6	35
15	30	6	38
18	34	6	42
21	39	7	48
24	43	7	52
27	48	8	57
30	55	10	65
36	63	11	73
42	72	12	83
48	80	13	91
54	90	14	102
60	96	14	108
72	112	16	124

6. Unauthorized trench widths: Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing table, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor. Excessively large trench widths in roads shall not be compensated for extra pavement restoration outside prescribed trench widths.

7. Trench bottom in earth: The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to the grade to which the embedment is to be laid. The surface shall be graded to provide a uniform bearing and continuous support. No part of the bell shall be in contact with the trench bottom.

8. The Contractor shall sort and stockpile excavated material so that suitable material is available for backfill. Excavated material shall be deposited on the side of the trenches and beyond the reach of slides. Excavated material not suitable for backfill shall be promptly removed from the site.

9. Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes, but sloping trench walls shall not extend lower than 1 foot above the top of the pipe.

10. Trench Shields: Where trench shields are used by the Contractor, no part of the shield shall exceed lower than 6 inches above the top of the pipe, nor shall the maximum allowable trench width be exceeded.

11. Topsoil displaced due to trenching shall be carefully stockpiled and placed back on top of the trench when backfilling.

3.6 PIPE EMBEDMENT

A. Embedment Classes: Embedment classes shall be as follows, and as detailed on the Drawings. All lifts are given in loose thickness. All compaction percentages refer to maximum dry density as determined by ASTM D-698. Select backfill material shall be compacted within 2% of optimum moisture content.

1. Class A Embedments:

   a) Class A-1 embedment shall provide a cradle of concrete with a compressive strength of at least 3,000 psi, as specified in section 03300. After the initial set of the concrete, granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%, above the top of pipe.

   b) Class A-2 embedment shall provide an arch of concrete with a compressive strength of at least 3,000 psi, as specified in section 03300. After the initial set of the concrete, granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%, up to the top of pipe. One foot of select backfill material shall be placed above the top of pipe, placed in 8-inch thick, loose lifts and compacted to a minimum of 85%.

2. Class B Embedments:

   a) Class B-1 embedment shall provide an encasement of granular embedment material, extending below the pipe to above the top of pipe. Granular embedment material shall be placed in 6-inch lifts and compacted to a minimum of 90%.

   b) Class B-2 embedment shall provide a cradle of granular embedment material which shall be placed in 6-inch lifts and compacted to a minimum of 90%. Select backfill material shall then extend above the top of the pipe, placed in 8- inch lifts and compacted to 85%.

3. Class C Embedment: Materials and compaction requirements shall be as for Class B-2.

4. Class D Embedment: Shall allow the pipe to rest on a flat or restored trench bottom. Pipe embedment shall be select backfill material extending from the bottom of the pipe to above the top of pipe, placed in 12-inch lifts and compacted to 85%.

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

C. Pipe Embedment Class Schedule: Unless otherwise noted on the

Drawings, pipe embedment classes shall be provided according to the following schedule:

Pipe Material	Depth over pipe	Embedment class
SDR-35 PVC	6"	B-1
SDR-PR PVC	6"	D
C-900 PVC	6"	D
DIP (ductile iron)	6"	B-2
Other types not listed here	6"	B-1

D. Placement of Embedment:

1. Place embedment material at the trench bottom with proper allowance for bell joints. Level materials in continuous layers not exceeding 6 inches in compacted depth. Shovel slicing of embedment shall be performed along the sides of the pipe as embedment is placed, to consolidate the bedding and haunching below the pipe.

2. Consolidate granular embedment by rodding, spading and compacting as necessary to provide uniform pipe support and meet the compaction requirement.

3.7 BACKFILLING:

A. General:

1. All trenches and excavations around structures shall be backfilled to finish grade according to the drawings. Backfill with material as specified herein.

2. Large compaction equipment, including self propelled compaction equipment, bulldozers, loaders, and boom-mounted vibratory plates, shall not be used within 3 feet above the top of pipe, or within 3 feet of new or existing structures.

3. If backfilling operations do not meet the specifications, the material shall be removed, replaced and recompacted at the Contractor's

expense.

4. Backfill shall not be placed when material is frozen, contains frost, snow, waste material, trees, organic matter and rubbish or when the surface to receive backfill is snow covered or frozen.

5. No backfill shall be placed over or around any structure until the concrete or mortar has attained a minimum compressive strength of 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 trenches beneath proposed structures, or in areas which have or will have a paved or chip-and-seal surface, or where indicated on the drawings to use granular backfill material:

a. Granular backfill material shall be placed on the compacted pipe embedment, in layers not to exceed 9 inches loose thickness and compacted.

b. Granular backfill material shall be compacted by vibratory means. Each lift of granular backfill material shall be compacted to a minimum 95 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 2 or minus 2 percent of optimum. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.

2. For trenches in graveled areas, or other vehicle traveled ways which are neither paved nor surfaced with chip-and-seal material:

a. Granular backfill material shall be placed on the compacted pipe embedment, in layers not to exceed 9 inches loose thickness and compacted.

b. Granular backfill material shall be compacted by vibratory means. Each lift of granular backfill material shall be compacted to a minimum 95 percent of maximum density as determined by ASTM D-698. Backfill shall be placed and compacted at a moisture content within plus 2 or minus 2 percent of optimum. Extreme care shall be used in

compaction operations to prevent compacting equipment from contacting the pipe.

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 9 inches in loose thickness and compacted.

   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.

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 for structures within paved or graveled areas shall be granular backfill material, compacted in place to 95% of maximum density as determined by ASTM D-698, at a moisture content within plus 2 or minus 2 percent of optimum. Granular backfill shall be placed in lifts not to exceed 8 inches in loose thickness, and compacted by careful pneumatic or vibratory tamping.

3. Structure backfill for structures in other areas shall be select fill material, placed in lifts not to exceed 9 inches in loose 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.

3.8 SURFACE RESTORATION

A. All areas disturbed by construction operations shall be restored by paving,

gravel surfacing, seeding, or sodding as indicated on the Drawings and specified.

3.9 IMPERVIOUS TRENCH CHECK:

A. Trench checks shall be placed where indicated on the drawings, or at a maximum interval of 400 feet. There shall be at least one trench check between manholes.

B. Trench checks shall extend the full width of the trench, and the length and depth shall be as indicated on the drawings. Trench check material shall be placed completely under, around and above pipe, and shall be placed in maximum loose lifts of 8 inches in thickness and compacted to 95% of maximum density as determined by ASTM D698. Extreme care shall be used in compaction operations to prevent compacting equipment from contacting the pipe.

3.10 DISPOSAL OF MATERIALS

A. All unused excess excavated material, together with all debris, removed pipe, stones, stumps, roots, and other unsuitable materials shall be removed from the site and disposed of by the Contractor, at the expense of the Contractor.

B. Material to be disposed of, including excess material, shall be promptly removed from the site by Contractor. If Contractor desires to set aside excess excavated material free from contamination by sewage or other hazardous substances, he shall do so only in an area approved by the Owner.

3.11 SOIL TESTING: The Contractor shall provide for sampling and testing of all trench backfills and material for impervious trench checks:

A. Laboratory Tests:

1. Two initial gradation tests and two initial moisture-density (Proctor) tests shall be made for each type of embedment, backfill, and trench check material, including job excavated materials.

a. Initial test results on materials which are imported (not job excavated) shall be submitted as product data for review in accordance with the submittals section.

2. One additional gradation test and one additional moisture-density

test shall be made for each additional 400 tons of imported material and 200 cubic yards of job excavated backfill.

B. Field Tests:

1. During the progress of the work of filling and backfilling, in-place density tests shall be performed with a nuclear density gage by a qualified laboratory technician.

2. The number of tests to be taken and the locations thereof shall be determined by the Engineer based upon observation of the filling or backfilling process. A minimum of two (2) tests per 300 cubic yards of fill/backfill and two (2) tests per 500 feet of trench shall be taken unless otherwise directed by the Engineer. One additional test shall be performed on each trench check. One additional test shall be taken at driveway or roadway crossing that is disturbed by open cut.

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

C. Compensation:

1. All costs for testing shall be performed by the Contractor at the Contractor's expense.
2. Contractor to use an independent Lab approved by the Engineer for Soil Testing.

END OF SECTION

SECTION 02510

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphaltic concrete paving surface course.

B. Asphaltic concrete paving base course.

C. Subgrade preparation.

D. Aggregate base course.

1.2 RELATED SECTIONS

A. 02220 – Earthwork & Trenching

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Asphaltic Concrete Pavement Base Course:
   1. Basis of Measurement: By the square yard.

B. Asphaltic Concrete Pavement Surface Course:
   1. Basis of Measurement: By the square yard.

C. Compacted Aggregate Base:
   1. Basis of Measurement: **no measurement will be made, aggregate base shall be included in the unit bid item of the Asphalt.**

1.4 REFERENCES

A. Missouri Standard Specifications for Highway Construction, Missouri Highway & Transportation Commission (MHTC), 2011 edition.

B. Midwest Concrete Industry Board (MCIB) Standard Specifications, Section 4, aggregate materials.

C. ASTM C - 117: Test Method for Material Finer Than No. 200 Sieve in Mineral Aggregates by Washing.

D. ASTM C - 136: Test Method for Sieve Analysis of Fine and Coarse Aggregates.

E. ASTM D - 698: Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.

F. ASTM D - 946: Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.

G. ASTM D - 979: Methods for Sampling Bituminous Paving Mixtures.

H. ASTM D - 1075: Test Method for Effect of Water on Cohesion of Compacted Bituminous Mixtures.

I. ASTM D - 1559: Resistance to Plastic Flow of Bituminous Mixtures Using the Marshall Apparatus.

J. ASTM D - 1856: Test Method for Recovery of Asphalt from Solution by Abson Method.

K. ASTM D - 2171: Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer.

L. ASTM D - 2172: Test Method for Quantitative Extraction of Bitumen from Bituminous paving Mixtures, Method 'A'.

M. ASTM D - 4552: Standard Practice for Classifying HOT MIX Recycling Agents.

N. MS - 2: Mix Design Methods for Asphalt Concrete and Other HOT MIX Types, Asphalt Institute.

1.5 QUALITY ASSURANCE

A. Obtain materials from same source throughout.

B. All work within the public right-of-way is subject to inspection by the Owner.

1.6 SUBMITTALS

A. Submit certified laboratory test reports sufficient to verify compliance of specified mix design for all asphalt products.

B. Submit temperature-viscosity relationship data for each asphalt used on the project.

PART 2 PRODUCTS

2.1 ASPHALT MATERIALS

A. All material shall conform to Division 1000, Missouri Standard Specifications for Highway Construction, 2011 edition.

2.2 ASPHALT ACCESSORIES

A. Primer: Homogeneous, medium curing, liquid asphalt, Type MC-70.

B. Tack Coat: Homogeneous, medium curing, liquid asphalt, Type RC-70.

C. Sand Cover: Sand cover used for blotting excess primer shall be clean granular mineral meeting the following gradation:

Sieve Size	Percent Passing
No. 4	100
No. 200	0 - 2

The moisture content of the sand shall not exceed 3 percent by weight.

2.3 ASPHALT PAVING MIX

A. Use dried and heated material to avoid foaming. Mix uniformly.

B. Asphaltic Concrete Base Course, shall conform to Section 401, Plant Mix Bituminous Base Course, (Missouri Standard Specifications for Highway Construction, 2011 edition). Mineral Aggregates shall conform to the following gradation:

Sieve Size	Percent Passing By Weight
1"	100
1/2"	60 - 90
No. 4	35 - 65
No. 8	25 - 50
No. 30	10 -35
No. 200	5- 12

1. In addition to the above limits, the difference between the "percent passing" of successive sieve sizes shall not exceed 25 percent.

2. At the Contractor's option Asphalt Base may contain up to 50 percent Reclaimed Asphalt Pavement (RAP) and/or Reclaimed Aggregate Materials (RAM).

3. Recycled Asphaltic Concrete Material shall have the following additional tests performed:
   a. ASTM C-117 Standard Test Method for Material Finer than No. 200 Sieve in Mineral Aggregates by Washing.
   b. ASTM C-136 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. ASTM D-2172 Standard Test Methods for Quantitative Extraction of Bitumen from Bituminous Paving Mixtures, Method "A".

4. The extracted asphalt from Method "A" ASTM D-2172 shall be reclaimed from solution in accordance with ASTM D-1856 Standard Test Method for Recovery of Asphalt from Solution by Abson Method.
   a. The consistency of the asphalt shall be determined on the basis of viscosity at 140 degrees F in accordance with ASTM D-2171 Standard Test Method for Viscosity of Asphalts by Vacuum Capillary Viscometer.
   b. The grade of asphalt used in recycled mixes shall be the same grade as for virgin mixes.

5. New asphalt cement added to recycled asphalt shall meet the requirements of ASTM D-3381, Standard Specification for Viscosity-Graded Asphalt Cement for use in Pavement Construction or ASTM D-946, Standard Specification for Penetration-Graded Asphalt Cement for use in Pavement Construction.

6. Any material obtained from cut-back asphaltic concrete streets or road-oil-chip seal streets is unacceptable for recycled asphaltic concrete.

7. Recycling Agents, if used, shall meet the requirements of ASTM D-4552 Standard Practice for Classifying HOT MIX Recycling Agents.

8. The blend of RAP and/or RAM and virgin aggregates shall be checked for resistance to stripping. Use ASTM D-1075 Standard Test Method for effect of Water on Cohesion of Compacted Bituminous Mixtures. The index of retained strength shall exceed 75 percent.

9. Maintain stockpiles of RAM and RAP at the plant separated on the basis of mix type-surface, binder and base. Stockpiles shall be free of foreign matter. RAM and/or RAP shall be processed such that 100 percent passes the 1 1/2 inch sieve and 90 percent passes the 1 inch sieve.

10. RAP and/or RAM stockpiles shall be free of all foreign matter, including but not limited to ice, wood, soil, broken sewer castings, loop detector wire, joint filler material, lane markers, trash and debris.

11. Mix Design Requirements: Mix design for recycled mixtures shall be in accordance with the Asphalt Institute's Manual Series No. 20 (MS-20) titled Asphalt Hot-Mix Recycling Section 3.00.

12. All delivery tickets of asphaltic pavement material shall designate the type of recycled mix (RC - Type 1, RC - Type 2, RC - Type 3, or RC - Type 4).

C. Asphaltic Concrete Surface Course Type I-C: Surface course Type I-C shall consist of all virgin material with 4 to 8 percent of asphalt cement by weight in mixture. Mineral aggregates shall conform to the following gradation:

Sieve Size	Percent Passing By Weight
1"	---
3/4"	100
½"	90 - 100
3/8"	60 - 90
No. 4	40 - 65
No. 8	25 - 45
No. 16	18 - 35
No. 30	12 - 25
No. 50	7 - 9
No. 100	4 - 11
No. 200	2 - 7

1. In addition to the above limits, the difference between the "percent passing" of successive sieve sizes shall not exceed 20 percent.

2.4 AGGREGATE BASE COURSE

Section 1007.2 Type 1 Aggregate (Missouri Standard Specifications for Highway Construction, 2011 edition.

A. Coarse aggregate base shall be crushed stone free of lumps or balls of clay and any other soft or objectionable material. Gradation shall be in accordance with the following:

Sieve Size	Percent Passing By Weight
1"	100
½"	60 - 90
No. 4	40 - 60
No. 40	15 - 35

2.5 SOURCE QUALITY CONTROL

A. Provide tests of mix design for asphalt under provisions of Section 01400.

B. Submit proposed mix design of each class of mix for review prior to commencement of work.

C. Asphaltic concrete test samples shall be taken according to ASTM D-979 and tested for Bitumen content according to ASTM D-2172.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify base conditions are according to the plans and specifications.

B. Verify that subgrade under the new pavement section is compacted to 95 percent standard maximum density and is dry and free from all loose and foreign material.

C. Verify that the area to be paved is true to line and grade.

3.2 SUBBASE

A. Subgrade shall be compacted to 95 percent of the standard maximum density. If proper compaction cannot be achieved, scarify top 6 inches of subgrade, moisture condition, and compact to 95 percent standard maximum density.

3.3 GEOTEXTILE SEPARATION FABRIC

A. Not Used.

3.4 COMPACTED AGGREGATE BASE COURSE

A. Verify that the subgrade has been cleared of all foreign matter and has been compacted to the specified density.

B. Place aggregate base course to the width and thickness indicated in the plans. Care shall be taken not to tear or disturb geotextile fabric. Any such tears shall be repaired per manufacturers' written instructions prior to final rock placement. The material shall be uniformly spread in successive layers to achieve the specified depth, but in no case shall any individual layer have a compacted thickness greater than 4 inches. Each layer shall be compacted to at least 95 percent maximum density, according to ASTM D-698, prior to placing any additional material.

C. After spreading, the aggregate shall be kept at the proper moisture content to insure the specified compaction. Water shall be added and uniformly mixed in such a manner to prevent segregation. Excess moisture creating runoff shall be avoided. If the aggregate and subgrade become too wet for proper work and compaction, the materials shall be allowed to dry sufficiently.

D Work causing segregation of the aggregate is not permitted. If segregation of the aggregate in excess of 10 percent variation from the specified gradation or if the materials become contaminated, the segregated and contaminated material shall be removed and replaced with suitable material at the Contractor's expense. The in-place gradation shall be tested by a sieve analysis of a minimum of 100 pounds if in-place base course. If crushed stone is used, the segregated surface areas may be corrected by adding limestone screens of the gradation and quantity required to fill the surface voids and create a firmly bound material.

E. Shape and compact the aggregate base continuously until the proper grade, cross-section and specified density have been obtained. Final rolling shall be performed with a self-propelled smooth wheeled roller.

3.5 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when ambient temperature is less than 40 degrees F, or when there is frost in the subgrade or any other time when weather conditions are unsuitable for the type of material being placed.

B. The minimum temperature of asphaltic concrete when placing shall be 285° F when the ambient temperature is 40° - 50° F, 280° F when the ambient temperature is from 50° - 60° F and 275° when the ambient temperature is above 60° F.

C. Do not place asphalt when water is standing on the surface to be paved.

3.6 PREPARATION - PRIMER

A. Not Required.

3.7 ASPHALTIC CONCRETE PLACEMENT

A. Placement and finishing of each course shall be according to the thickness and width indicated on the plans. The thickness of individual lifts shall not exceed 4 inches for base course and 2 inches for surface course.

B. Install any storm drainage inlet grates and frames, manhole frames and other structures in correct position and elevation prior to laying asphalt.

C. The base and surface courses shall be spread and struck-off with mechanical paving machines meeting the requirements set forth in Missouri Standard Specifications for Highway Construction, Section 304 and 401.

D. Longitudinal joints and edges shall be constructed to true line markings. The lines used for placement of individual lanes will be established parallel to the roadway. The pavers shall be positioned and operated to follow the established line. When using pavers in echelon, the second paving machine shall follow the asphalt edge placed by the first machine.

E. Immediately after spreading the first load of asphalt pavement, check the texture of the unrolled surface for uniformity. Segregation of materials

shall not be permitted. If segregation occurs, suspend spreading operations immediately until the cause is determined and corrected.

F. Traverse joints in successive courses shall be offset a minimum of two feet and longitudinal joints shall be offset a minimum of six inches.

G. Edges which are to receive additional pavement shall be beveled at a 30° angle with the vertical plane. Form the true line and beveled edge immediately behind the paver with a lute or rake. Excess material shall be removed and indentations shall be filled with hot mix and smoothed. Fanning of material shall not be permitted.

H. Irregularities in the alignment shall be corrected by trimming directly behind the paving machine. Immediately after trimming, the edges shall be thoroughly compacted by tamping, avoiding any distortion to the pavement.

I. Hand place asphaltic concrete in those areas inaccessible to the paving machinery.

1. Distribute asphalt material uniformly to avoid segregation. Broadcasting of material shall not be permitted.

2. Using lutes and rakes thoroughly loosen and uniformly distribute the asphalt material. Lumps and material which does not readily break down shall be rejected.

3. Following hand placing and prior to rolling, check the surface for irregularities with templates and straight edges. All irregularities shall be corrected.

J. When placing the surface course adjacent to any existing or previously finished surface, it shall be placed sufficiently high so that after compaction the finished surface shall be smooth and uniform with the adjacent surface.

3.8 ASPHALTIC CONCRETE PAVEMENT COMPACTION

A. The rolling equipment used for compaction of asphaltic pavement shall conform to the requirements setforth in the Missouri Standard Specifications for Highway Construction, 2011 edition, Section 401. A minimum of two rollers shall be required at all times.

B. Compact pavement by rolling. Do not displace or extrude pavement from position. Any displacement resulting from reversing the direction of the roller, or from any other cause, shall be corrected immediately using rakes and adding fresh asphalt when required.

C. To prevent adhesion of asphalt to the roller, the wheels shall be kept properly moistened. Excess water will not be permitted.

D. Traverse Joints: Traverse joints shall be carefully constructed as specified and thoroughly compacted to provide a smooth riding surface.

1. Repair or correct the joint surface if it has become distorted. The joint shall be trimmed to a line. Apply a thin coating of asphalt tack coat to the joint face prior to placing fresh asphalt against it.

2. Traverse joints shall be held to a minimum. At the end of the day's paving operation all lanes shall be completed to approximately the same station.

E. Longitudinal Joints: Longitudinal joints shall be rolled directly behind the paving operation.

1. The first lane shall be placed true to line and grade. The asphalt material
shall overlap the edge of the previously placed lane by 2 to 4 inches. The width and depth of the overlap shall remain uniform along the length of the joint.

2. Before rolling, the coarse aggregate in the material overlapping the joint shall be carefully removed with a rake or lute and discarded.

F. Edges: Pavement edges shall be rolled concurrently with or immediately following rolling the longitudinal joint.

1. Before compaction, the material along the unsupported edge shall be slightly elevated with a tamping tool or lute. During rolling the wheels shall extend approximately one inch beyond the edge of the pavement.

G. Initial Rolling: Initial or breakdown rolling shall immediately follow rolling of the longitudinal joints and edges and as close behind the paving machine as practical to obtain the specified density without causing displacement.

1. Initial rolling shall be performed with a smooth-wheeled roller having the drive wheel nearest the finishing machine.

2. Rolling shall be longitudinal, commencing at the nearest edge of the pavement and proceeding toward the center while working from the low side to the high side. Overlap of the roller on successive trips shall not be less than one-third and no more than one-half the width of the roller. Vary the length of alternate rolling trips.

3. Initial rolling shall take place as closely behind the paving machine as the temperature and mat condition will allow.

H. Intermediate Rolling: Intermediate rolling shall follow initial rolling as closely as possible and while the asphalt is still at a temperature which will result in the maximum density.

1. The pneumatic-tire roller used for intermediate rolling shall conform to the requirements setforth in the APWA Standard Specifications, Section 2205.

2. Intermediate rolling shall be continuous until all of the asphalt pavement has been compacted to the required density. Turning pneumatic-tired rollers on hot asphalt which causes displacement shall not be permitted.

I. Finish Rolling: Finish rolling shall be performed while the pavement is warm enough to remove all roller marks.

1. A trench roller shall be used for finish rolling. Finish rolling shall continue until the course is thoroughly compacted with a smooth surface true to crown and grade.

J. At the completion of the compaction and rolling operations the asphaltic concrete base shall have a minimum density of 95 percent. The asphaltic concrete surface course shall have a density of 97 percent. All unsatisfactory work shall be corrected, repaired or replaced. The surface course shall have a uniform texture and conform to the lines and grades shown on the plans.

3.9 ASPHALT PAVEMENT TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from True Elevation: Within 1/4 inch.

3.10 FIELD QUALITY CONTROL

A. All work within the public right-of-way is subject to inspection by the City of Versailles.

3.11 PROTECTION

A. Immediately after placement, protect pavement from mechanical injury until asphalt is sufficiently cooled so as not to be damaged by traffic loads.

END OF SECTION

SECTION 02730

SEWAGE PIPING SYSTEMS

1PART GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install all required sewer and wastewater piping, fittings, embedment materials, and all accessories for complete and functional piping systems as shown on the Drawings and specified herein.

B. Section Includes:

1. Sanitary gravity sewer and force main piping, fittings, and accessories.

2. Gravity sewer acceptance testing.

3. Force main/pressure sewer/pressure piping acceptance testing.

1.2 RELATED SECTIONS:

A. Section 02220 - Earthwork and Trenching for trenching, embedment, and backfill.

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

A. Midwest Concrete Industry Board (MCIB) Standard Specification for Concrete Work.

B. ASTM D-1784: Rigid Poly (Vinyl Chloride) Compounds And Chlorinated Poly (Vinyl Chloride) Compounds

C. ASTM D-1785: Poly (Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, 120

D. ASTM D-2241: Poly (Vinyl Chloride) Pressure-Rated Pipe (SDR Series)

E.	ASTM D-2321	Recommended Practice For Underground Installation Of Flexible Thermoplastic Sewer Pipe
F.	ASTM D-2464	Threaded Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80
G.	ASTM D-2466	Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
H.	ASTM D-2467	Socket-type Poly (Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 80
I.	ASTM D-2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
J.	ASTM D-2855	Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
K.	ASTM D-2729:	Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
L.	ASTM D-2837:	Obtaining Hydrostatic Design Basis For Thermoplastic Pipe Materials.
M.	ASTM D-3034:	Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.
N.	ASTM D-3139:	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
O.	ASTM D-3212:	Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals.
P.	ASTM F-477:	Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
Q.	ASTM F-679:	Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
R.	ASTM F-894:	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
S.	ASTM F-1417:	Standard Test Method for Installation Acceptance of Plastic Sewer Lines Using Low-Pressure Air.

T. ANSI/AWWA C104/A21.4: Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water

U. ANSI/AWWA C110/A21.10: Ductile-Iron and Gray-Iron Fittings 3 In. Through 48 In.

V. ANSI/AWWA C111/A21.11: Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

W. ANSI/AWWA C115/A21.15: Flanged Ductile Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

X. ANSI/AWWA C150/A21.50: Thickness Design of Ductile Iron Pipe.

Y. ANSI/AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

Z. ANSI/AWWA C153/A21.53: Ductile Iron Compact Fittings 3 In. Through 24 In. and 54 In. Through 64 In. For Water Service.

AA. ANSI/AWWA C105/A21.5: Polyethylene Encasement for Ductile Iron Pipe Systems

BB. AWWA C900: Poly (Vinyl Chloride) (PVC) Pressure Pipe, 4 in. Through 12 in. for Water Distribution

CC. Uni-B-13-92: Uni-Bell PVC Pipe Association "Recommended Performance Specification for Joint Restraint Devices for Use With Polyvinyl Chloride (PVC) Pipe.

1.4 DEFINITIONS

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

1.5 SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Product Data for Review:

1.Pipe and joint materials and details.

2. Details and materials of fittings, pipe accessories, and specials.

3. Specifications, data sheets, and affidavits of compliance for protective shop coatings and linings.

4. Pressure gauge certification and calibration data.

C. Manufacturer's Certificates: Contractor shall furnish the following prior to shipment:

1. Affidavit of compliance with applicable standard.

2. Test certificates.

D. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

1.6 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01700.

B. Record location of pipe runs, connections, and invert elevations.

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

1.7 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.

1.8 FIELD MEASUREMENTS

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

1.9 COORDINATION

A. Coordinate sanitary sewer and wastewater pressure piping construction with other work.

2 PART PRODUCTS

2.1 PIPE MATERIALS

A. Notes on Materials: Each pipe material below is given an alphanumeric abbreviation shown in parentheses, which is shown on the drawings to denote the applicable specified material for the given size and service. PVC SDR-21-PR pipe shall be used for forcemain piping.

1. PVC SDR-26 shall be used for gravity sewer piping.

2. Ductile iron pipe shall be used for lift station, valve vault, and connecting piping.

B. Type PSM Polyvinyl Chloride Sewer Pipe and Fittings:
Shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds, and ASTM D-3034 for poly vinyl chloride (PVC) sewer pipe.

1. Minimum wall thickness shall conform to Standard Dimension Ratio 26 (SDR 26).

2. The Contractor shall install the maximum pipe lengths manufactured by the supplier.

3. 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.

4. Restrained Joint PVC: 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 matched 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.

5. Fittings: Fitting joints shall be bell and spigot with elastomeric gaskets conforming to ASTM D-3212,, 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.

   a. Fittings defined as tee or wye connections suitable for assembly to 4-inch or 6-inch sewer service laterals shall be bell-end and shall be furnished by the pipe manufacturer.

B. Polyvinyl Chloride Plastic Pressure Pipe and Fittings (SDR-PR PVC): Shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds, and ASTM D-2241 for poly vinyl chloride (PVC) pressure pipe.

1. The resin portion of the copolymer compounds shall contain a minimum of 70 percent vinyl chloride and the compounding ingredients shall not exceed 30 percent by weight. The compounding ingredients may consist of lubricants, stabilizers, non poly (vinyl chloride) resin modifiers, and pigment essential for processing, property control, and coloring.

2. Minimum wall thickness shall conform to Standard Dimension Ratio 21 (SDR 21).

3. The Contractor shall install the maximum pipe lengths manufactured by the supplier.

4. Joints: Joints shall be push-on type with integral bell and spigot and elastomeric gaskets meeting the requirements of ASTM D-3139. Rubber gasket rings shall be neoprene or other synthetic material and conform to ASTM F-477. Natural rubber gaskets will not be acceptable.

5. Fittings: Shall meet the requirements of ASTM D-1784 cell classification 12454-B for PVC compounds. Fitting joints shall be bell and spigot with elastomeric gaskets, meeting the requirements of ASTM D-3139. Where specifically indicated on the drawings or

directed by the Engineer, socket type Schedule 80 fittings in conforming with ASTM D-2467, with solvent cemented joints in conformance with ASTM D-2855, shall be used.

C. Ductile Iron Pipe (DIP):

1. Pipe: Ductile iron, meeting the requirements of ANSI/AWWA C151/A21.51. Pipe shall have a wall thickness conforming to Special Thickness Class 53.

2. Joint Types: Where types of joints in ductile iron piping are indicated on the Drawings, these shall govern. Where not indicated on the Drawings, the following types of joints shall be used: All joints for piping inside wetwells, vaults, exposed locations, and other locations indicated on the Drawings shall be flanged joints. Joints for buried piping shall be restrained mechanical joint for sections of pressure conduits requiring joint restraint, as specified in Part 3 of this Section. Joints for concrete encased piping and buried piping not requiring joint restraint shall be either mechanical joint or push-on joint.

3. Joint Requirements:

a) Flanged Joints: Flanges shall be threaded-on, flat faced ductile iron, conforming to ANSI/AWWA C115/A21.15. Bolts shall be steel, ASTM A307. Nuts shall be ASTM A307 steel with ANSI/ASME B.18.2.2 heavy semifinished pattern. Gaskets shall be full faced synthetic rubber, 1/8" thick, conforming to Appendix B of ANSI/AWWA C111/A21.11.

b) Push-on Joints: Shall conform to ANSI/AWWA C111/A21.11. Push-on joint gaskets shall be neoprene or synthetic rubber.

c) Mechanical Joints: Shall conform to ANSI/AWWA C111/A21.11. Mechanical joint gaskets shall be neoprene or synthetic rubber.

d) Restrained Mechanical Joints: Restrained mechanical joints shall utilize a follower gland incorporating individually activated wedges, with a rated working pressure of 350 psi. The restraining gland shall be capable of full mechanical joint deflection during assembly, and flexibility

shall be maintained after burial. Restraining wedges shall be one piece, circular shaped that has continuous contact with the pipe.

4. Fittings: Flanged fittings shall conform to ANSI/AWWA C110/A21.10, 250 psi pressure rating. Mechanical joint fittings shall conform to ANSI/AWWA C110/A21.10, 350 psi pressure rating. Compact fittings conforming to ANSI/AWWA C153/A21.53. shall be used in ductile iron piping only where specifically indicated on the Drawings or approved by the Engineer.

5. Lining: All pipe and fittings shall be provided with cement-mortar lining conforming to ANSI/AWWA C104/A21.4, or a 30 mil polyethylene lining in accordance with ASTM D -1248.

6. Asphaltic Coating: Exterior surfaces of all pipe which is to be buried or completely concrete encased, including fittings, shall receive a shop applied one-mil thick asphaltic coating. Asphaltic coating shall conform to AWWA C115, AWWA C110, and AWWA C153, as applicable.

7. Shop primer: Exterior surfaces of all pipe and fittings to be located completely or partially inside wetwells or vaults, or in exposed locations, shall be blast cleaned to near-white metal per SSPC-SP10 and shop coated with a high solids alkyd-phenolic primer to a dry film thickness of 3.0 mils.

8. Polyethylene Tube: Shall be seamless, ANSI/AWWA C105/A21.5.

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. Banded couplings shall be provided to transition between different materials and sizes as required.

B. 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.

C. 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.

D. Mechanical couplings: Mechanical couplings shall be gasketed, sleeve-type, sized to properly fit the pipes to joined, with steel or ductile iron middle ring, steel or ductile iron follower rings, and synthetic rubber gaskets. Gasket material 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, Style 153, or Style 162", or Smith-Blair “441 or 411” or approved equal.

E. Flanged Coupling Adapters: Flanged coupling adapters shall have cast iron/ductile iron body and follower, and synthetic rubber gasket. Body shall have anchor studs or locking pins. Surfaces shall be shop primed for field painting. Flanged coupling adapters shall be Dresser “Style 127" or Smith-Blair “Type 912" or Romac Style FCA501 or approved equal.

F. Wall Castings: Wall castings shall be ductile iron, cast as a single piece or fabricated. Ends shall be plain end, mechanical joint, or flanged as indicated on the drawings.

G. Tracer Wire: Tracer wire shall be #12 THHN copper location wire.

H. Valves and Accessories:

1. Flap gate: Flap gate shall be heavy duty cast iron with flange back frame with 125 lb. ANSI standard drilling. Hinge pins and seat faces shall be bronze.

2. Gate valves: Gate valves shall be iron-body, resilient-seated, tight closure gate valves with non-rising stems, “O”-ring type packing, and complying with AWWA C509. The waterway of the valve in the fully open position shall be unobstructed. All buried gate valves shall be specifically designed for buried use and shall be equipped with mechanical joint ends. The gate valve wedge shall have Buna “N: or SBR rubber bond to both sides to form a double seal when the valve is closed. Buried valves shall be equipped with a 2" square operating nut and all exposed gate valves shall be equipped with handwheel or chain operators unless indicated otherwise on

the drawings. All valves shall open counterclockwise. The valve interior and exterior shall be coated with epoxy paint standard with the valve manufacturer.

3. Valve extension stems: When the distance from grade to the top of the operating nut exceeds 3 feet, buried valves shall be provided with a valve stem extension as shown on the drawings. Two (2) 2" square valve wrench with 5' T-bar handle shall be furnished. Buried valve operators shall have valve position indicators.

4. Valve boxes and covers: Valve boxes shall be constructed using a length of 6 inch cast iron or PVC CLS 200 pipe, valve box base, cover and lid as shown on the drawings. Lids on wastewater lines shall be stamped “sewer”.

5. Air release valve: Valve shall be installed in a meter pit as shown on the drawings. The gate valves shall be bronze, screwed, non-rising stem, 175 psi working pressure. The air release valve shall be APCO model 443 or Valmatic “VM-801", Crispin model US20 or Engineer approved equal. All piping shall be brass piping except the air outlet from the air release valve which shall be copper tubing. Meter pit cover shall have 30" lid, 7 ½ “ depth and be provided with opening key.

6. Check valves: Check valves shall be lever and spring operated type with flanged ends conforming to ANSI B16.1, Class 125. The check valve shall be suitable for operation in the position indicated with adjustable spring tension on valve operating lever. The check valve shall have a cast iron body, bronze mounted stainless steel hinge pin, rubber faced disc and bronze seat ring.

2.3 GRANULAR EMBEDMENT MATERIAL

A. Granular embedment material shall be as specified in Section 02220, Earthwork and Trenching.

2.4 BACKFILL MATERIALS

A. Backfill materials shall be as specified in Section 02220, Earthwork and Trenching.

2.5 STEEL CASING

A. 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:

Diameter of Casing-Inches	Nominal Wall Thickness-Inches Under Railroads	All other Uses
8-16	0.250	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 have welded joints in accordance with AWWA C 206.

B 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.

C. Casing end seals: Ends shall be sealed with synthetic rubber, wrap around end seals with stainless steel bands.

3 PART EXECUTION

3.1 EXAMINATION

A. Verify that the 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 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 and identify utilities that remain and protect them 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 and stakes from damage or displacement. If property or lot corner markers must be moved, they shall be properly referenced prior to removal and reset by the Contractor upon completion of the project.

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. See Section 01000 - General Requirements 19. Separation of Water and Sewer Utilities

3.5 SERVICE LINES AND CONNECTIONS

A. There shall be one service connection made as shown on the plans. Unless otherwise noted on the plans, a service connection shall consist of connecting to the existing pipe, within 5 feet of the outer wall, with a clean-

out and constructing new line to the sewer main and connecting with a tee or wye fitting. Additional clean-outs shall be placed at changes in alignment of 45 degrees or greater and at a maximum of 150 foot intervals.

3.6 PIPE EMBEDMENT/ENCASEMENT

A Material and installation for pipe embedment and concrete encasement shall be provided as indicated on the Drawings and specified in Section 02220 - Earthwork and Trenching.

3.7 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. Unless otherwise noted on the Drawings, minimum cover over top of pipe shall be 42 inches. 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 for clay pipe, D-3034 and F-679 for plastic gravity sewer pipe, F-714 for polyethylene pipe, ANSI/AWWA C600 for ductile iron pipe. The pipe manufacturer’s maximum recommended deflection limits, if more stringent, shall govern over the referenced standards.

1. Only one correction for alignment and/or grade shall be made between structures.

2. 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. Place embedment material uniformly and simultaneously on each side of the pipe to prevent lateral displacement. Embedment material shall be compacted as specified in Section 02220 - Earthwork and Trenching.

I. Pipe Jointing: Locate joints to provide for differential movement at changes in type of embedment, concrete collars and encasement and structures. Pipe 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 sharp edges.

K. Point Repairs and Connection to Existing Pipe: Where point repairs in existing sewer lines are required, the following shall apply:

1. Replacement length shown on the drawings is approximate and measured to the nearest pipe joint. Actual replacement shall proceed to the nearest sound pipe joint as approved by the Engineer or the Owner's representative.

2. Replacement length shown on the drawings plus 3 feet on either end shall be considered incidental to the Work at the location.

3. Pipe connections to existing pipe shall be made with banded couplings as specified herein.

L. Pipe connection to structures:

1. 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. Gravity sewer 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.

M. Tracer wire shall be installed so that it will lay on the top of all new forcemain pipe. Wire shall extend up and connect to markers as directed by Engineer. Markers shall be 4"x4" treated wood posts. They shall be at least 60" in length and shall have external terminals for tracer wire. Markers shall be placed near fences where applicable.

3.8 DUCTILE IRON PIPING:

A. Handling: Pipe and fittings shall be handled and installed carefully to prevent damage to pipe material, linings, and coatings. Hooks placed in ends of pipe or fittings shall have well-padded surfaces. All coatings which are damaged shall be repaired by the Contractor prior to installation, to the satisfaction of the Engineer.

B. Cutting: Pipe shall be shop fabricated to the approximate lengths required. Pipe shall not be cut in the field, except where flange adapters are indicated on the Drawings or where allowed by Engineer. Pipe may be cut with a portable saw, abrasive wheel, or oxyacetylene torch. The use of hydraulic squeeze type cutters will not be permitted. Cuts shall be smooth, straight, and at right angles to the pipe axis. Cut edges shall be dressed with a file or power grinder to remove all roughness and sharp edges.

C. Flanged Joints: Flange faces shall be machine faced with pipe end, flat and perpendicular to the pipe axis. When bolting flanged joints, care shall be taken to avoid restraint on the opposite end of the pipe or fitting, which would cause unnecessary stress in the flanges. Bolts shall be tightened gradually and uniformly, to ensure uniform compression of the gasket.

D. Mechanical Joints: Mechanical joints shall be assembled according to the manufacturer's recommendations. If the joint does not form an effective seal, the joint shall be completely disassembled, thoroughly cleaned, and reassembled. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Mechanical joints shall be restrained where specified herein.

E. Push-on Joints: Push-on joints shall be assembled according to the manufacturer's recommendations. Each spigot end shall be suitably beveled to facilitate assembly. All joint surfaces shall be lubricated with heavy vegetable soap solution immediately before the joint is completed.

F. 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.

G. All buried ductile iron pipe shall be provided with polyethylene tube protection installed in accordance with AWWA C105, Method A.

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 & 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 a 6 foot spacing, whichever provided 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.

E. 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.

4.0 JOINT RESTRAINT FOR PRESSURE PIPING: Joint restraint shall be provided for portions of piping which will serve in a pressure flow application, including: force mains, pressure sewers, and process piping.

A. Joint restraint for SDR-PR PVC pressure pipe shall be accomplished by means of thrust blocks, as shown and detailed on the drawings or by the use of bell restraint clamps for joints between pipes, and fitting restraint devices at joints with fittings, where shown on the drawings and as specified herein. Joints shall be restrained for minimum distance from fittings as given in the table below.

LENGTH (ft) OF RESTRAINED JOINT REQUIRED: SDR-21 PVC PIPE

Pipe Size	90° Bend Horizontal	45° Bend Horizontal	45° Bend Vertical	22° Bend	Tee Branch[1] (equal size)	Reducer (one size)
2"	10	5	10	5	5	10
3"	10	5	10	5	5	10
4"	10	5	10	5	5	10
6"	15	10	10	5	5	10
8"	20	10	15	5	5	15
10"	25	10	15	10	5	15
12"	25	15	20	10	10	20

[1] In the straight-through direction, the minimum length of the first pipe on either side of the tee shall be 10 feet.

B. Joint restraint for ductile iron piping shall be accomplished using mechanical joints with restraining glands. Joints shall be restrained for minimum distance from fittings as given in the table below.

LENGTH (ft) OF RESTRAINED JOINT REQUIRED: DUCTILE PIPE (with polyethylene wrap)

Pipe Size	90° Bend Horizontal	45° Bend Horizontal	45° Bend Vertical	22° Bend	Tee Branch[1] (equal size)	Reducer (one size)
4"	10	5	10	5	5	20
6"	15	5	15	10	10	20
8"	20	10	20	10	15	20
10"	25	10	25	15	25	20
12"	25	15	30	15	35	20
14"	30	15	30	15	40	20

16"	35	15	35	20	50	25

[1] In the straight-through direction, the minimum length of the first pipe on either side of the tee shall be 10 feet.

4.1 GRAVITY SEWER ACCEPTANCE TESTING:

A. All new sewer segments between manholes or structures 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. Construction Inspector 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 ans 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.

1. 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.

2. Test each reach of pipe between manholes after completion of pipe and appurtenance installation and trench backfill.

3. 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.

4. 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.

5. 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 Size	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
8"	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
15"	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18"	17:00	25:38	32:03	38:37	44:52	51:16	57:41

21"	19:50	34:54	43:37	52:21	61:00	69:48	78:31
24"	22:47	45:34	56:38	68:22	79:46	91:10	102:23
27"	28:51	57:41	72:07	86:32	100:57	115:22	129:48

6. 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.

7. 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 diametral deflection test on all flexible and semi-flexible pipe (such as PVC plastic pipe). Tests shall be conducted between manholes or structures. Deflection testing of a segment of sewer shall occur at least 30 days after the pipe has been installed and completely backfilled.

2. The maximum allowable deflection shall be five percent of the inside pipe diameter. A mandrel with a diameter equal to 95 percent of the inside diameter of the pipe to be tested shall be used. Any section of sewer failing the diametral deflection test shall be repaired or replaced by the Contractor at no cost to the Owner, and retested.

E. Compensation for Testing:

1. All testing of pipe and manholes shall be performed by the Contractor at the Contractor’s expense.

4.2 PRESSURE PIPING ACCEPTANCE TESTING

A. All new sewer force mains, pressure sewers, 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 pressure shall be 120 psi (gauge). This pressure will not exceed the thrust-restraint design pressure.

2. The hydrostatic test shall be of at least a 2-hour duration. Test pressure shall not vary by more than $\pm$5 psi for the duration of the test.

D. Test materials: Contractor shall supply all of the necessary plugs, hose, riser pipe, pumps, gauges, water and other equipment as required for the testing.

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 if 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. 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.

4.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01400.

B. Compaction and soil testing will be performed in accordance with Section 02220.

END OF SECTION

SECTION 02738

MANHOLES AND COVERS

1 PART GENERAL

1.1 The Contractor shall furnish and install all manholes/wetwells, covers, and accessories, and perform all repairs to existing manholes, as shown on the Drawings and specified herein, and tested by Contractor for approval by the Engineer.

1.2 SECTION INCLUDES

A. New sanitary sewer manholes/wetwells and appurtenances

B. Manhole wall reconstruction.

C. Pipe connections to manholes/wetwells.

D. Manhole testing.

1.3 RELATED SECTIONS

A. Section 02220 – Earthwork and Trenching

B. Section 02730 – Sewage Piping System

1.4 REFERENCES

A. Midwest Concrete Industry Board (MCIB) Standard Specification for Concrete Work.

B. ASTM A-48 Gray Iron Castings

C. ASTM A-615 Deformed And Plain Billet-Steel Bars For Concrete Reinforcement

D. ASTM C-32 Sewer And Manhole Brick (Made From Clay Or Shale)

E. ASTM C-139 Concrete Masonry Units For Construction Of Catch Basins And Manholes

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

1.5 SUBMITTALS

A. Submit under provisions of Section 01300 - Submittals.

B. Product Data for Review:

1. Manholes/wetwells, castings, manhole appurtenances.

2. Manhole repair products.

3. Repair mortar.

4. Calculation for structural design of manholes/wetwells.

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.

1.6 FIELD MEASUREMENTS

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

2 PART PRODUCTS

2.1 AGGREGATE AND BACKFILL MATERIALS

A. Crushed rock: Crushed rock material used as a foundation and for leveling of manholes/wetwells, shall be MoDOT Type 1" clean rock. Granular pipe embedment material may also be used.

B. Backfill materials shall be select backfill clean of debris 6" and larger.

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

A. Precast manholes/wetwells: 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 precast concrete shall be 4000 psi with Type II cement. Concrete poured on site shall be 3,000 psi. 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.

1.Precast concrete manholes/wetwells 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 cast 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.

A. Adjusting rings: Adjusting rings shall be precast concrete, with circumferential reinforcement per ASTM C-478.

B. 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.

C. 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, Deeter Model 1320, Neenah Model 1536 or approved equal with "Sewer" cast on the lid. Castings for shallow manholes shall be Clay and Bailey Model No. 2002, Deeter Model 1332, Neenah Model 1538 or approved equal with “Sewer” cast on lid. Castings for “bolt-down lid” manholes and lids shall be Clay and Bailey Model No. 2014LT, Deeter Model 1313, Neenah 1916-F or approved equal.

D. Protective coating: The protective coating for the interior and exterior of manholes shall be a coal tar system with 64% solids, $\pm$ 2%.

E. 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. The sealant shall contain no asbestos fibers and meet ASTM C-990 standards.

F. Clay brick: Clay or shale brick shall conform to the requirements for ASTM C-32, Grade MS or SM. Brick may be either solid or cored.

G. Mortar/Grout: Mortar/grout for brick work and other uses as required shall be a general construction grade grout prepared to a stiff, trowelable consistency. Grout product shall be a non-shrink, non-catalyzed grout containing mineral aggregate, and having a minimum compressive strength of 8,500 psi at 28 days in a plastic consistency. Grout shall meet ASTM C-1107, Grade A standards.

1. Preparation of grout mortar: Grout shall be prepared according to the recommended proportions of the manufacturer. Grout mortar may be extended with clean aggregate as recommended by the manufacturer. Grout mortar shall be mixed only in such quantities as needed for immediate use. The retempering of grout mortar will not be permitted.

A. Repair Mortar: Repair mortar 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. Repair mortar shall meet ASTM C-109-92 standards.

2.3 MANHOLE ACCESSORIES

A. 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.

B. Flexible entrance seals: Cast-in-place flexible entrance seals shall be made of materials meeting the properties in ASTM C-923. The connector shall meet or exceed the performance requirements in ASTM C-923.

3 PART EXECUTION

3.1 NOT USED

3.2 NEW MANHOLES: New manholes/wetwells shall be constructed of precast concrete sections, with cast iron frames and covers in accordance with the Drawings and as specified herein.

A. Manholes/wetwells shall be designed for the depth shown on the Drawings. The wall thickness and reinforcing shall be increased, if necessary, to handle the loads. All manholes/wetwells shall be designed to the most recent ACI 318 code.

B. 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 and or the Owner.

C. Inspection: Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

D. Manhole/wetwell construction:

1. Precast concrete manholes/wetwells with cast-in-place base: Construct manhole with precast concrete section on a cast-in-place concrete foundation slab as shown on the Drawings. Concrete base shall be poured over a base of crushed stone. Joint seals between each riser section shall be installed in strict conformance with manufacturer's recommendations. Damaged exterior coating shall be touched up and allowed to dry prior to backfilling.

2. Precast concrete manholes/wetwells with a developed base: Precast manholes with a developed base shall be placed on a base of crushed stone as detailed on the Drawings. The crushed stone base shall be graded smooth, level and to the correct grade. The bottom riser section shall be placed upon the crushed stone 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.

E. 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 no more than 2 inches per foot.

3. Invert channels shall be formed in the field using either concrete readi-mix, or clay brick and mortar as specified herein. Where brick and mortar used, 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.

F. Flexible entrance seals: Where cast-in-place flexible entrance seals are used to seal pipe connections to new manholes/wetwells, 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.

G. Frames and covers: Unless shown otherwise on the Drawings, all castings shall be set flush with finish grade in all roadways, 2 inches above grade in lawns, and at least 12 inches above finish grade in all other areas.

3.3 MANHOLE WALL RECONSTRUCTION:

A. Where damaged by the Contractor's operations, required by other sections, or indicated on the Drawings, the walls of existing manholes shall be rebuilt using clay brick and mortar. If repair of the manhole wall is adjacent to the sewer pipe wall penetration, repair mortar shall be used in place of mortar.

B. Where joining new work or repair work to existing surfaces, the existing surfaces shall be solid, clean, and sufficiently rough to create a good bond. If surfaces of existing materials are not solid or are prone to crumbling, Contractor shall remove existing materials as required to reach a clean, hard surface.

C. Exterior faces of masonry shall be plastered at least 1/2" thick with mortar.

3.4 PIPE CONNECTIONS TO MANHOLES/WETWELLS:

A. Pipe connection to new manholes/wetwells shall be as shown on the Drawings.

B. Pipe connection to new manholes/wetwells shall be made with cast-in-place flexible entrance seals wherever possible, following the entrance seal manufacturer's instructions.

C. Pipe connection to existing manholes, and to new manholes/wetwells where boxouts are used shall be made with approximately two inches clearance surrounding the pipe or fitting. A pipe grouting ring shall be placed around the outside of the pipe where the pipe enters the manhole. The opening between the pipe and structure shall be filled with repair mortar to form a water tight seal.

D. 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 repair mortar.

E. Repair Mortar: Repair mortar used to fill voids around pipes or to repair walls and benches of manholes shall be mixed, applied, and cured according to the manufacturer's recommendations.

1. Preparation: Surfaces to receive repair mortar shall be solid and free of oil and grease. The concrete surfaces to receive repair mortar shall be

saturated or in a saturated, surface-dry condition as recommended by the manufacturer. The mix may be extended with pea gravel or other suitable aggregate, as limited by the manufacturer's recommendations.

2. Mixing shall be accomplished with a slow speed drill equipped with a paddle or an appropriate size mortar mixer.

3. Placement: Repair mortar used to fill voids and holes shall be hand-placed in plastic form or poured in flyable form, as required by the manufacturer's recommendations for the product used.

4. Application of repair mortar in vertical and horizontal layers shall conform to the thickness limitations of the manufacturer.

5. Curing: Repair mortar shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. The repair mortar shall be wet cured for at least 7 days. As an alternative to moisture curing, a two-coat application of a curing compound recommended by the manufacturer may be used.

3.5 MANHOLE TESTING

A. Manhole leakage test: All new precast manholes and all rehabilitated manholes shall pass a vacuum leakage test.

B. Notification: Contractor shall notify Engineer at least 48 hours in advance the scheduled time for testing. Construction Inspector 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 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 in the specifications, 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 vacuum testing, the manhole shall be disassembled, the seal replaced and the manhole restored.

3.6 FIELD QUALITY CONTROL

Field inspection and testing will be performed under provisions of Section 01400 - Quality Control.

3.7 PAYMENT

A. Standard manhole is defined as a 48" I.D. manhole of depth 8'. Depth greater than 8' shall be paid for by foot for extra depth. Outside drop manholes are a separate bid items. No extra payment is allowed for outside drop manholes greater than 8' depth. Manholes of larger I.D. are to be paid for by separate bid item. No extra payment is given for extra depth manhole of I.D. greater than 48".

B. Although payment is allowed for standard manholes of depth greater than 8', no extra payment will be allowed for greater depths caused by manholes and corresponding sewer mains installed to elevations and slopes other than what is shown on the drawings due to installation errors.

END OF SECTION

SECTION 02920

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Providing all plant, labor, equipment, and materials and performing all operations necessary for final grading, fertilizing, seeding, liming, and mulching the areas as specified herein.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.

C. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

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

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Product Certificates: For fertilizers, signed by product manufacturer.

D. Qualification Data: For landscape Installer.

E. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods. **(NOT APPLICABLE)**

F. Records of all inspections. **(NOT APPLICABLE)**

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress. **(NOT APPLICABLE)**

1.6 DELIVERY, STORAGE, AND HANDLING

A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.

1.7 SCHEDULING

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 15 – May 15.
2. Fall Planting: August 15 – September 30.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 AREAS TO BE TREATED

A. Turf shall be established on all disturbed areas outside the building and paving or per site seeding plan.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species: Seed of grass species as follows, with not less than 85 percent germination, not less than 98 percent pure seed, and not more than 0.8 percent weed seed:

1. Turf Type Fescue for lawns, lagoon embankments, pastures, and areas disturbed not in the land application area.

2. Land Application Areas: Brome, Red Clover, and Winter Wheat.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural limestone containing a minimum 85 percent calcium carbonate equivalent and as follows:
1. Class: Class O, with a minimum 95 percent passing through No. 8 sieve and a minimum 55 percent passing through No. 60 sieve.

2.3 FERTILIZER

A. Fertilizer shall be uniform in composition and free flowing. Fertilizer shall be 12-12-12.

1. Application Rate: 500 pounds per acre or as recommended by soils tests.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, threshed straw of wheat, oats, or barley.
1. Application Rate: 2 tons per acre.

2.5 SOIL STABILIZER

A. Stabilize the mulch with a synthetic emulsion similar to HYDRO STOCK 8500. Apply stabilizer uniformly in accordance with the manufacturer's recommendations. In lieu of emulsions, it is acceptable to embed or anchor the mulch into the soil by using an approved disc type roller having flat serrated discs spaced not more than 10 inches apart and equipped with cleaning scrapers.

2.6 WATER

A. Water shall be free from oil, acid, alkali, salt, etc., and shall be from an approved source prior to use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

B. Provide and maintain existing erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways. **(NOT APPLICABLE)**

3.3 LAWN PREPARATION

A. Limit lawn subgrade preparation to areas to be planted.

B. Prior to fertilizing, liming, and seeding operations and after final grading, the areas to be seeded shall be harrowed or raked to provide a smooth seed bed.

3.4 SEEDING – LAWNS, LAGOON EMBANKMENTS AND PASTURES

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at the rate of 8 to 10 pounds / 1,000 square feet for turf type fescue.

C. Rake seed lightly into top 1/8 inch of topsoil, roll lightly. Watering with fine spray is optional.

3.5 SEEDING – LAND APPLICATION AREA

A. Sow seed with a drill or seeder followed by incorporation. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow winter wheat at a rate of 45 lbs/acre, brome at 15 lbs/acre, and red clover at 8 lbs/acre/

C. Apply winter wheat, brome and one-half of the recommended fertilizer in September or October. Apply red clover and the second half of the recommended fertilizer in the late winter.

3.6 SATISFACTORY LAWNS

A. Satisfactory Seeded Lawn: Acceptance of seeded areas will be based upon having a dense, well-rooted turf, capable of preventing all erosion. Grass areas which show signs of erosion, ruts, etc., will not be acceptable. Seeded areas shall be mowed to a height of three inches immediately prior to inspection re-establish lawns that do not comply with requirements until lawns are satisfactory.

3.7 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established. **(NOT APPLICABLE)**

C. Remove erosion-control measures after grass establishment period. **(NOT APPLICABLE)**

END OF SECTION

SECTION 03100

CONCRETE FORM WORK

1.0 GENERAL

1.1 SECTION INCLUDES

A. Form work for cast-in place concrete, with shoring, bracing and anchorage.

B. Openings for other work.

C. Form accessories.

D. Form stripping.

1.2 RELATED SECTIONS

A. Section 03200 - Concrete Reinforcement.

B. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

A. ACI 301 - Specifications for Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements for Reinforced Concrete.

C. ACI 347 - Recommended Practice For Concrete Form Work.

D. ACI 350 - Environmental Engineering Concrete Structures.

1.4 DESIGN REQUIREMENTS

A. Construct form work, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.5 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Product Data: Provide data on void form materials, installation requirements and form ties.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347, 301, 318, and 350.
B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable ACI 301 code for design, fabrication, erection and removal of form work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Material and Equipment: Transport, handle, store, and protect products.

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.9 COORDINATION

A. Section 01039 - Coordination and Meetings: Procedures for coordination of work.

B. Coordinate this Section with other Sections of work which require attachment of components to form work.

C. If form work is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Engineer before proceeding.

2.0 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Form Materials: Exterior grade plywood at least 5/8 inch thick, smooth where exposed to view after construction.

2.2 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Preformed Plastic Forms: Thermoplastic form liner, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.3 FORM WORK ACCESSORIES

B. Form Ties: Removable type, galvanized metal or plastic, fixed or adjustable length, cone type, with waterproofing washer, 1-1/2 inch, back break dimension, free of defects that could leave holes larger than 1-1/4 inch in concrete surface.

C. Form Release Agent: Colorless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.

D. Corners: Chamfer, rigid plastic or wood strip type; 3/4 x 3/4 inch size; maximum possible lengths.

E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain form work in place while placing concrete.

4.0 EXECUTION

4.2 EXAMINATION

A. Verify lines, levels and centers before proceeding with form work. Ensure that dimensions agree with Drawings.

4.3 EARTH FORMS

A. Hand trim sides and bottom of earth forms. Remove loose soil prior to placing concrete.

4.3 ERECTION - Form work

A. Erect form work, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.

B. Provide bracing to ensure stability of form work. Shore or strengthen form work subject to overstressing by construction loads.

C. Arrange and assemble form work to permit dismantling and stripping. Do not damage concrete during stripping.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not indicated on Drawings.

F. Provide chamfer strips on external corners of beams and walls.

G. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

4.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on form work in accordance with manufacturer's recommendations.

B. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are effected by agent. Soak inside surfaces of untreated forms with clean water. Keep coated surfaces protected prior to placement of concrete.

4.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded or passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in form work where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

4.6 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless form work and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

4.7 FORM WORK TOLERANCES

A. Construct form work to maintain tolerances required by ACI 301.

B. Camber slabs and beams 1/4 inch per 10 feet (2 mm/m), in accordance with ACI 301.

4.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection and testing.

B. Inspect erected form work, shoring, and bracing to ensure that work is in accordance with form work design, and that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood form work more than 2 times for concrete surfaces to be exposed to view. Do not patch form work.

D. Do not use manufactured adjustable shores if wear, damage or defects make them incapable of supporting the loads for which they are designed.

4.9 FORM REMOVAL

A. Beam and wall forms may be removed as soon as the concrete is strong enough to sustain its own weight, but no sooner than 24 hours after placement. Do not remove supporting forms and shoring for level slabs, sloping slabs, beams, and other flexural members until they can support their weight and superimposed loads, and if test cylinders show a strength of 3,000 psi or more in compression, but not sooner than 14 days. Cure test cylinders under conditions similar to those affecting the

structure involved.

B. Distribution structures and some floor slabs are supported by walls and beams cast later. Do not remove forms and shoring under those slabs until 14 days after the walls and beams have been cast.

C. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

E. Store removed forms in such a manner so that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

1.0 GENERAL

1.1 SECTION INCLUDES

A. Reinforcing steel bars, wire fabric and accessories for cast-in-place concrete.

1.2 RELATED SECTIONS

A. Section 03100 - Concrete Form Work.

B. Section 03300 - Cast-in-Place Concrete.

1.3 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 318 - Building Code Requirements For Reinforced Concrete.

C. ACI 350 - Environmental Engineering Concrete Structures.

D. ACI SP-66 - American Concrete Institute - Detailing Manual.

E. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

G. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.

H. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.

I. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

J. ASTM D3963/D3963M - Standard Specification for Epoxy-Coated Reinforcing Steel.

K. AWS - American Welding Society.

L. CRSI - Concrete Reinforcing Steel Institute - Manual of Practice.

M. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.

N. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.

1.4 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Shop Drawings: Indicate bar sizes, spacings, locations, quantities of reinforcing steel, bending and cutting schedules, and supporting and spacing devices.

1.5 SUBMITTALS FOR INFORMATION

A. Section 01300 - Submittals: Procedures for submittals.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Submit certified copies of mill test report of reinforcement analysis.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI Manual of Practice, Chapter 5 of ACI 301, ACI SP-66, and Chapters 7 and 12 of ACI 318.

B. Maintain one copy of each document on site.

1.7 COORDINATION

A. Coordinate with placement of Form Work, formed openings and other Work.

2.0 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars, unfinished.

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions, including load-bearing pad on bottom. Clay bricks are not allowed.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI Manual of Practice and ACI 318. Heating of reinforcing steel for bending is not allowed.

B. Welding reinforcement will not be allowed.

3.0 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Position wall dowels projecting from foundations, with templates or guides held in place above the concrete placement line. Position the templates to obtain the required clearance between the dowels and the face of the walls.

C. Accommodate placement of formed openings.

D. Stagger bar splices. Minimum splice length = 40 bar diameters, unless otherwise shown on the drawings.

E. Provide additional reinforcing bars to support top reinforcement in slabs. Do not shift reinforcing bars from positions in upper layers to positions in lower layers as a substitute for additional support bars.

F. Provide additional reinforcing bars to support ties and stirrups in beams where top reinforcement is not continuous unless otherwise shown on the Drawings, do not bend reinforcing bars which project from in-place concrete.

G. Maintain concrete cover around reinforcing as follows:

Item	Coverage
Slabs and Joists:	
Top and Bottom Bars for Dry Conditions:	
#14 and #18 bars	1-1/2 in. (38 mm)
#11 and smaller bars	1 in. (25 mm)
Formed concrete surfaces exposed to earth, water or weather, and over or in contact with sewage and for bottoms bearing on work mat, or slabs supporting earth cover:	
All bars	2 in. (50 mm)
Beams and Columns:	
For dry Conditions:	
Stirrups, spirals and ties	1-1/2 in. (38 mm)
Principal reinforcement	2 in. (50 mm)
Exposed to earth, water, sewage, or weather:	
Stirrups and ties	2 in. (50 mm)
Principal reinforcement	2 1/2 in. (64 mm)
Walls:	
For Dry Condition:	
#11 and smaller bars	1 in. (25 mm)
#14 and #18 bars	1-1/2 in. (38 mm)
Formed concrete surfaces exposed to earth, water, sewage, weather, or in contact with ground:	
Circular tanks with ring tension	2 in. (50 mm)
All others	2 in. (50 mm)
Walls 12 in. or over in thickness with pours more than 10 ft	2 1/2 in. (63 mm)
Floorings and Base Slabs:	
At formed surfaces and bottoms bearing on concrete work mat	2 in. (50 mm)
At unformed surfaces and bottoms in contact with earth	3 in. (76 mm)
Top of footings - same as slabs	
Over top of piles	2 in. (50 mm)

H. Electrical grounding of reinforcement - Not Used

3.2 FIELD QUALITY CONTROL

A. Section 01400 - Quality Control: Field inspection.

3.3 SCHEDULES

A. Reinforcement For All Structures: Deformed bars, unfinished.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

1.0 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete floors, slabs, suspended slabs, walls, foundation walls.

B. Control, expansion and contraction joint devices associated with concrete work, including joint sealants.

C. Equipment pads, light pole base, thrust blocks, manholes, and vaults.

1.2 RELATED SECTIONS

A. Section 03100 - Concrete Form Work.

B. Section 03200 - Concrete Reinforcement.

1.3 REFERENCES

A. ACI 301 - Structural Concrete for Buildings.

B. ACI 302 - Guide for Concrete Floor and Slab Construction.

C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

D. ACI 305R - Hot Weather Concreting.

E. ACI 306R - Cold Weather Concreting.

F. ACI 308 - Standard Practice for Curing Concrete.

G. ACI 318 - Building Code Requirements for Reinforced Concrete.

H. ACI 350R - Environmental Engineering Concrete Structures.

I. ASTM C33 - Standard Specification for Concrete Aggregates.

J. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

K. ASTM C150 - Standard Specification for Portland Cement

L. ASTM C231 - Standard Test Method for Air Content of Freshly-mixed Concrete by the Pressure Method.

M. ASTM C260 - Standard Specification for Air Entraining Admixtures for Concrete.

N. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.

O. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

P. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).

Q. ASTM D1190 - Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type.

R. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

S. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.4 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Product Data: Provide data on joint devices, joint sealants, attachment accessories, and admixtures.

1.5 SUBMITTALS FOR PROJECT CLOSEOUT

A. Section 01700 - Contract Closeout: Submittals for contract closeout.

B Project Record Documents: Accurately record actual locations of embedded utilities and components which are concealed from view.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from same source for all work.

D. Conform to ACI 305R when concreting during hot weather.

E. Conform to ACI 306R when concreting during cold weather.

1.7 COORDINATION

A. Section 01039 - Coordination and Meetings: Provisions for the coordination of the work.

B. Coordinate the placement of joint devices with erection of concrete form work, placement of form accessories, and equipment supplier's requirements.

2.0 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cementitious Materials

1. For pavements, walkways and architectural concrete work, general purpose buildings, Portland Cement ASTM C150, Type I.

2. For concrete tanks, reservoirs and other structures used in water containment, industrial and domestic water and waste water treatments works, Portland Cement ASTM C150, Type II.

3. Portland Cement ASTM C150, Type III, high early strength, only where directed.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Only chloride free admixtures are acceptable. The manufacturer to list the chloride content of the admixture. Make sure admixtures selected are compatible and not harmful to the concrete mix.

B. Air Entrainment: ASTM C260.

1. MB-VR manufactured by Master Builders, Inc. Cleveland, OH.

2. DAREX II-AEA manufactured by W.R. Grace & Co., Cambridge, MA.

3. SIKA AER manufactured by Sika Corporation, Lyndhurst, NJ.

4. Substitution: Under provisions of Section 01600.

C. Chemical: ASTM C494, Type A - Water Reducing, Type D - Water Reducing and Retarding. Other admixtures shall be used only with Engineer's written concurrence.

1. Products manufactured by W.R. Grace & Co. Cambridge, MA.

2. Products manufactured by Euclid Chemical Co. Cleveland, OH.

3. Products manufactured by Gifford-Hill & Co., Charlotte, NC.

4. Substitution: Under provisions of Section 01600.

2.3 ACCESSORIES

A. Bonding Agent: Two component modified epoxy resin.

1. EUCO #352 manufactured by Euclid Chemicals, Co., Cleveland, OH.

2. Sikadur-32 Hi-Mod manufactured by Sika Corporation, Lyndhurst, NJ.

3. Section 01600 - Materials and Equipment: Product options and substitutions.

B. Non-Shrink Grout: Section 3600 - Grout

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler Type A: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile;

B. Joint Filler Type B: ASTM D1752, Type III; Premolded self-expanding cork, fully compressible with recovery rate of minimum 95 percent;

C. Sealant and Primer: Two-part polysulfide-base elastomeric sealant for water immersed joints.

1. Sonolastic two-part, Grade NS, manufactured by Sonneborn Building Products, Minneapolis, MN.

2. Hornflex-L two-part, Grade NS manufactured by A.C. Horn, Inc. Beltsville, MD.

3. Sikaflex two component, Grade NS manufactured by Sika Corporation, Lyndhurst, NJ.

4. Eucolastic II two-part, Grade NS manufactured by Euclid Chemical Co., Cleveland OH.

5. Substitution: Under provisions of Section 01600.

2.5 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94.

B. Select proportions for normal weight concrete in accordance with ACI 301.

C. Provide concrete which has minimum shrinkage cracks, high durability, high impermeability and maximum resistance to natural or processing chemicals. Provide concrete to meet the following criteria:

Class A: Concrete placed against earth in slabs and footings.

1. Minimum number of bags (pounds) of cement per cubic yard of concrete: 6.00 (564).

2. Maximum water-cement ratio: 0.45.

3. The ratio of sand to total aggregate: 33 to 42 percent by weight based upon surface dry material.

4. Compressive strength (7 days): 3,000 psi (21 Mpa).

5. Compressive strength (28 days): 4,000 psi (28 Mpa).

6. Maximum Slump: 3 inch (76 mm).

Class B Concrete in supported slabs, beams, and walls.

1. Minimum number of bags (pounds) of cement per cubic yard of concrete: 6.00 (564).

2. Maximum water-cement ratio: 0.45.

3. The ratio of sand to total aggregate: 33 to 42 percent by weight based upon surface dry material.

4. Compressive strength (7 days): 3,000 psi (21 Mpa).

5. Compressive strength (28 days): 4,000 psi (28 Mpa).

6. Maximum Slump: 3 inch (176 mm).

Class C: Concrete in fillets, cradles and where used to fill voids or for foundation backfilling and as a mud slab (non-structural applications) covering for subgrade at locations specifically designated on the Drawings.

1. Compressive strength (28 days): 3,000 psi (21 Mpa).

2. Maximum Slump: 4 inch (102 mm).

D. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Do not use calcium chloride.

F. Use set retarding admixtures during hot weather only when approved by the Engineer.

G. Contractor may use water-reducing, high-range admixture.

H. Add air-entraining admixture to all normal weight concrete mix. Ensure average air content in field mixtures equal to 6 percent plus or minus one percent (6 percent +- 1 percent), in conformance with ASTM C231. For concrete with trowel finished surfaces ensure minimum 3 percent air content.

3.0 EXECUTION

3.3 EXAMINATION

A. Section 01039 - Coordination and Meetings: Provisions for coordination and project conditions.

B. Verify requirements for concrete cover for reinforcement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed and positioned securely.

3.4 PREPARATION

A. Compact granular material under concrete before placing concrete.

3.5 PLACING CONCRETE

A. Place concrete in accordance with ACI 304.

B. Notify Engineer a minimum of 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, and embedded parts are not disturbed during concrete placement.

D. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.

E. Separate slabs on grade from vertical surfaces with 1/4 inch thick joint filler, unless otherwise shown on Drawings.

F. Extend joint filler from bottom of slab to within 1/8 inch of finished slab surface.

G. Install construction joint devices in coordination with floor slab placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

H. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

I. Place concrete continuously between predetermined control and construction joints.

J. Do not interrupt successive placement; do not permit cold joints to occur.

K. Saw cut joints within 24 hours after placing. Use 3/16 inch thick blade, cut into ¼ depth of slab thickness, or a minimum depth of 1 inch. Saw cuts shall be arranged so that floor panel lengths are no more than one and a half times the panel width. Maximum panel width is 10 feet.

L. Screed floors and slabs on grade, maintaining surface flatness of maximum 1/4 inch in 10 ft.

M. Take special care to prevent displacement or folding of waterstops. Exert extra effort to embed waterstop fully on both sides, in dense concrete.

N. At the bottom of wall pours and other horizontal construction joints, roughen, clean, and wet concrete surface against which new concrete is to be placed.

3.6 CONCRETE FINISHING

A. Finish concrete wall surfaces in accordance with ACI 301.

1. Smooth Form Finish: Concrete surfaces below grade adjacent to earth and surfaces not exposed to view such as enclosed chambers, vaults, wet wells, inside surfaces of open tanks, reservoirs, and basins.

2. Grout Cleaned Finish: Grout cleaned finish surfaces include, but are not limited to the following:

a. Exposed exterior walls of tanks and structures adjacent to earth to one foot below finished grade.

b. Interior surfaces in basements, tunnels, pipe galleries, equipment rooms and above grade area.

c. Surfaces to be painted, to be protected by coatings or liner.

B. Finish concrete floor surfaces in accordance with ACI 301.

1. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/8 inch per foot nominal or as indicated on Drawings.

3.7 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure concrete floor surfaces in accordance with ACI 308.

D. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

3.8 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400.

B. Provide free access to Work and cooperate with Inspection Personnel.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work. Unfavorable results of actual pours may necessitate redesign of mixes.

D. Performance Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

E. Three concrete test cylinders will be taken for every 50 or less cu yds of each class of concrete placed per day.

F. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. One slump test will be taken for each set of test cylinders taken.

H. One air content test will be taken for each set of test cylinders taken.

I. Record temperature of concrete sample for each strength test and atmospheric temperature at that time.

3.9 PATCHING

A. Allow Construction Inspector to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed in accordance with ACI 301.

3.10 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION

SECTION 03600

GROUT

1.0 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-shrinking grout.

2. Epoxy grout.

1.2 SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Product Data for Review:

1. Grout materials and data sheets.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

2.0 PRODUCTS

2.1 GROUT MATERIALS

A. Non-shrinking Grout: Non-shrinking grout shall be furnished factory premixed so only water is added at jobsite. Non-shrinking grout shall be pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, and shall develop a minimum compression strength of 2400 psi in 48 hours and 7000 psi in 28 days. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout.

1. Acceptable Products:
   a. “Cormix “Supreme”
   b. L&M “Crystex”
   c. Master Builders “Masterflow 713 Grout” or “Set Grout”
   d. Sauereisen Cements “F-100 Level Fill Grout”
   e. U.S. Grout “Five Star Grout”

f. UPCO “Upson Super Flow”
g. Or Equal.

A. Epoxy Grout: Epoxy grout shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application, and an inert aggregate filler component, when recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and field mixed. All proportioning and mixing of the components shall be in accordance with the manufacturer’s recommendations.

1. Epoxy Grout for Reinforcing Bent and Threaded Rod Anchors:
   a. For Floors and Horizontal Surfaces:
      1. Low Viscosity Moisture insensitive, Master Builders “Concresive 1463", Sika “Hi-Mod LV”, or equal.
      2. Medium Viscosity Moisture insensitive, Master Builders “Concresive 1001 LPL”, Sika “Hi-Mod” or equal.
   b. For Vertical Walls and Overhead Applications: Moisture insensitive, Nonsag consistency; Master Builders “Concresive 1441", Sika “Hi-Mod Gel”, or equal.

2. Epoxy Grout for Headed Anchor Bolts:
   a. Adhesive: Moisture insensitive;
   b. Aggregate: As recommended by the epoxy grout manufacturer.

B. Water: Water used to mix products shall be clean and potable. Questionable water shall be tested by a laboratory in accordance per ASTM C-94 procedure. Potable water need not be tested.

3.0 EXECUTION

3.1 NONSHRINKING GROUT: Nonshrinking grout shall be used for the grouting of all equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates, wall fittings, and other uses of grout as indicated on the Drawings. Unless otherwise specified, all grouting shall be done with nonshrinking grout.

A. Preparation: The concrete foundation to receive non-shrinking grout shall be saturated with water for 24 hours prior to grouting.

B. Placement: Unless otherwise specified or indicated on the drawings, the thickness of grout under baseplates shall be 1-1/2 inches. Grout shall be

placed in strict accordance with the directions of the manufacturer so all spaces and cavities below the top of baseplates and bedplates are completely filled, without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

C. Edge Finishing: In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate, bedplate, member, or piece of equipment.

D. Curing: Non-shrinking grout shall be protected against rapid loss of moisture by covering with wet rags or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least 7 days.

3.2 EPOXY GROUT:

A. Preparation: Where indicated on the drawings, anchor bolts and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete.

1. Diameter of holes shall be as follows:

a.	Reinforcing Bars and Threaded Rod Anchors	1/8 inch larger than the bar or rod outside diameter
b.	Headed Anchor Bolts	Bolt diameter plus 2 inches

2. The embedment depth for epoxy grouted anchor bolts, threaded rod anchors, and reinforcing bars shall be not less than 15 bolt, rod or bar diameter unless indicated otherwise on the drawings.

3. Holes shall be prepared for grouting as recommended by the grout manufacturer.

B. Installation:

1. Anchor bolts, threaded rod anchors, and reinforcing bars shall be clean, dry, and free of grease and other foreign matter at time of installation.

2. The bolts, rods, and bars shall be set and positioned, and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Particular care shall be taken to ensure that all spaces and cavities are filled with epoxy

grout, without voids.

3. During assembly of all threaded stainless steel components, anti-seize thread lubricant shall be liberally applied to the threaded portion not embedded in concrete.

END OF SECTION