



TETRA TECH

PROJECT MANUAL

CITY OF GRIFFIN

A. Z. Kelsey Avenue Project: Stream Restoration and Stormwater BMP Retrofits Project No. 100-ATL-T31130

100% Submittal

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Tt #100-ATL-T31130

CITY OF GRIFFIN
A.Z. KELSEY AVE PROJECT: STREAM RESTORATION AND
STORMWATER BMP RETROFITS

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SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.01 LOCATION OF WORK

- A. The Work of this Contract is located in The City of Griffin, Spaulding County, Georgia on property owned by the City of Griffin and within the right-of-ways of A.Z. Kelsey Avenue and North 3rd Street.

1.02 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and complete the Work in its entirety as shown on the Drawings and as specified herein.
- B. The Contractor shall perform the Work complete, in place, and ready for continuous service, including repairs, testing, permits, cleanup, replacements, and restoration required as a result of damages caused during this construction.
- C. All materials, equipment, skills, tools, and labor which are reasonably and properly inferable and necessary for the proper completion of the Work in a substantial manner and in compliance with the requirements stated or implied by these Specifications and Drawings shall be furnished and installed by the CONTRACTOR without additional compensation, whether specifically indicated in the Contract Documents or not.
- D. The CONTRACTOR shall comply with all municipal, county, state, federal, and other codes which are applicable to the proposed construction work.
- E. The Work includes, but is not necessarily limited to, the following:
 - 1. Removal of all storm piping, junction boxes, inlets, and appurtenances along the indicated areas shown on the drawings.
 - 2. Installation of 192 linear feet of (1) 10'x6' precast box culvert and wing walls across A.Z. Kelsey Avenue. Connection of all existing lateral storm pipes to new culvert. Relocation of all utilities necessary to install culvert including the lowering of the water main along A.Z. Kelsey Avenue as indicated on the drawings. Installation of drop inlets along A.Z. Kelsey Avenue along with removal and replacement of pavement and curb and gutter.
 - 3. Installation of 64 linear feet of (1) 12'x5' precast box culvert and wing walls across North 3rd Street. Connection of all existing lateral storm pipes to new culvert. Installation of double wing catch basin, curb and gutter, and pavement replacement.

4. Erosion control, site cleanup, asphalt replacement, sodding and seeding, and other restoration.
5. Construction of 960 feet of stream restoration, dry detention basin, and bioretention cells. Construction will be phased as indicated on the plans and will include routing stream flow around stream restoration activities using a diversion pump. Areas will be graded, constructed, stabilized, and planted according to the plans and specifications.
6. Replacement, protection, and/or relocation of miscellaneous utilities located along the Project route as required to perform the Work.

1.03 WORK SEQUENCE

- A. Perform Work in proper sequence to ensure completion of the Work within the Contract Time and as required by Section 01015

1.04 CONTRACTOR'S USE OF PREMISES

- A. CONTRACTOR shall limit the use of the premises for his/her work and for storage to allow for:
 1. OWNER occupancy and operation of the existing facilities. Construction operations shall be coordinated with OWNER and ENGINEER to minimize conflict and facilitate OWNER'S use of the existing facilities.
 2. Work by other Contractors.
 3. Public use and access.
- B. CONTRACTOR shall coordinate use of premises with other Contractors, ENGINEER, and OWNER.
- C. CONTRACTOR shall provide security for all products, materials, and equipment stored on the sites, including those of Subcontractors.
- D. CONTRACTOR shall, if directed by OWNER or ENGINEER, move any stored items which interfere with operations of OWNER or other Contractors.
- E. CONTRACTOR shall obtain and pay for use of additional storage or work areas if needed to perform the Work.
- F. On-site areas for construction staging and/or storage are within the limits of the road right-of-way as shown on the Drawings. CONTRACTOR shall obtain and pay for off-site staging/storage areas as required if on-site areas are insufficient for construction activities.

1.05 ABBREVIATIONS AND REFERENCES

- A. Whenever reference is made to the furnishing of materials or testing thereof to conform to the standards of any technical society, organization or body, it shall be construed to mean the latest standard code, specification or tentative specification adopted and published at the date of advertisement for bids, even though reference has been made to an earlier standard. The following list of specifications is hereby made a part of the contract the same as if herein repeated in full. In the event of any conflict between any of these specifications, standards, codes or tentative specifications, and the Specifications or in the event that one of the following conflict with another, the decision as to which shall govern will be decided by the ENGINEER whose judgment will be final.
- B. Reference to a technical society, organization, or body may be made in the Specifications by abbreviations, in accordance with the following list:

AASHTO	-	The American Association of State Highway and Transportation Officials
ACI	-	American Concrete Institute
AGA	-	American Gas Association
AGMA	-	American Gear Manufacturers Association
IEEE	-	Institute of Electrical and Electronic Engineers
AISC	-	American Institute of Steel Constructors
AISI	-	American Iron and Steel Institute
ANSI	-	American National Standards Institute
API	-	American Petroleum Institute
ASCE	-	American Society of Civil Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society of Testing Materials
AWPA	-	American Wood Preservers Association
AWS	-	American Welding Society
AWWA	-	American Water Works Association
CBD	-	Central Business District
FED.SPEC	-	Federal Specifications
CIPRA	-	Cast Iron Pipe Research Association
DIPRA	-	Ductile Iron Pipe Research Association
GA EPD	-	Georgia Environmental Protection Division
GDOT	-	Georgia Department of Transportation
NCPI	-	National Clay Pipe Institute
NEMA	-	National Electrical Manufacturers Association
NFPA	-	National Fire Protection Association
TCA	-	Tile Council of America Inc.
AWPA	-	American Wood Preservation Association
NAVY SPEC.	-	Navy Department Specification
NEC	-	National Electric Code
NLMA	-	National Lumber Manufacturers Association
SAE	-	Society of Automotive Engineers Standards

SHBI	-	Steel Heating Boiler Institute
SBCC	-	Standard Building Code Congress International, Inc.
DOT	-	Department of Transportation
U.L.	-	Underwriter's Laboratories, Inc.
OSHA	-	Occupational Health and Safety Act
SSPC	-	Steel Structures Painting Council

- C. When no reference is made to a code, standard, or specification, the standard specifications of ASTM, ANSI, ASME, IEEE, or NEMA shall govern.

1.06 WORK BY OTHERS

- A. The CONTRACTOR is advised that other construction may occur in the vicinity of this project. The CONTRACTOR is required to cooperate fully so as to eliminate or minimize the creation of conflicts.
- B. The CONTRACTOR shall afford other Contractors and the OWNER responsible opportunities for the introduction and storage of their materials and equipment and the execution of their work and shall properly connect and coordinate the work with other work. The CONTRACTOR shall coordinate his work with the OWNER and other Contractors to store his apparatus, materials, supplies, and equipment in such orderly fashion as will not unduly interfere with the progress of the work or the work of any other Contractors.
- C. Should the CONTRACTOR cause damage to the Work or property of the OWNER or of any separate Contractor on the project, or to other work on the site, or delay or interfere with the OWNER'S work on ongoing operations or facilities or adjacent facilities or said separate Contractor's work, the CONTRACTOR shall be liable for the same; and, in the case of another Contractor, the CONTRACTOR shall attempt to settle said claim with such other Contractor prior to such other Contractor's institution of litigation or other proceedings against the CONTRACTOR.
- D. If such separate Contractor sues the OWNER on account of any damage, delay or interference caused or alleged to have been so caused by the CONTRACTOR, the CONTRACTOR shall defend the OWNER in such proceedings at the CONTRACTOR'S expense. If any judgment or award is entered against the OWNER, the CONTRACTOR shall satisfy the same and shall reimburse the OWNER for all damages, expenses, attorney's fees and other costs which the OWNER incurs as a result thereof.
- E. Should a separate Contractor cause damage to the Work or to the property of the CONTRACTOR or cause delay or interference with the Contractor's performance of the Work, the CONTRACTOR shall present directly to said separate Contractor any claims it may have as a result of such damage, delay, or interference (with an information copy to the OWNER) and shall attempt to settle its claim against said separate Contractor prior to the institution of litigation or other proceedings against said Contractor.

- F. In no event shall the CONTRACTOR seek to recover from the OWNER or ENGINEER, and the CONTRACTOR hereby represents to the OWNER and the ENGINEER that it will not seek to recover from them, or either of them, any costs, expenses (including, but not limited to, attorney's fees), or losses of profit incurred by the CONTRACTOR as a result of any damage to the Work or property of the CONTRACTOR or any delay or interference caused or allegedly caused by any separate Contractor.

- G. Any difference or conflict which may arise between the CONTRACTOR and other Contractors who may be performing work on behalf of the OWNER, or between the CONTRACTOR and workmen of the OWNER in regard to their work shall be adjusted and determined by the ENGINEER. If the work of the CONTRACTOR is delayed because of any acts of omissions of any other Contractor of the OWNER, the CONTRACTOR shall on that account have no claim against the OWNER other than for a noncompensable extension of time.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01011

PERMITS AND AGREEMENTS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. The CONTRACTOR shall obtain and pay for any and all permits and licenses as provided for in the General Conditions, except as otherwise provided herein and in effect at the time of bidding.
- B. The CONTRACTOR shall schedule all inspections and obtain all written approvals of the agencies required by the permits and licenses.
- C. The CONTRACTOR shall comply with all construction-related conditions specified in each of the permits, encroachment agreements, easement agreements, and licenses obtained by the CONTRACTOR and OWNER.
- D. Copies of the permits, encroachment agreements, and applicable easement agreements obtained by the OWNER are attached at the end of this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PERMIT AND AGREEMENT CONDITIONS

- A. The CONTRACTOR shall honor the letter and the spirit of the respective permits, encroachment agreements, and easement agreements in addition to the Drawings and Specifications.
- B. Nothing in said permits, encroachment agreements, and easement agreements shall serve to decrease or negate the requirements of the Contract Documents.

3.02 SEDIMENT AND EROSION CONTROL PLAN

- A. All land-disturbing activities associated with this project are subject to the requirements of the approved Sediment and Erosion Control Plan and NPDES General Permit.
- B. Environmental protection requirements associated with the Sediment and Erosion Control Plan are described in Section 02270.

- C. If CONTRACTOR elects to secure staging and stockpile areas within the project site, CONTRACTOR shall install temporary sediment control devices around all such areas in accordance with the Erosion Control Specifications in the *Manual for Erosion and Sediment Control in Georgia*.
- D. The CONTRACTOR shall be responsible for completing all monitoring and preparing all inspections reports to be submitted GAEPD / City of Griffin. The CONTRACTOR shall be responsible for maintaining a copy of the approved Sediment and Erosion Control Plan on the construction site at all times. The CONTRACTOR shall display the sediment and erosion control approval certificate on the construction site at all times. The approved plan and approval certificate will be provided by the OWNER.
- E. Erosion control devices (silt fence, sediment tubes, construction entrances, etc.) will be installed as specified on the Drawings and in these Specifications. Where a device must be placed before construction, removed during construction and replaced following construction, no extra payment will be made for the removal and replacement operations. At a minimum, devices will be installed as shown on the Drawings. Additional devices may be installed by the CONTRACTOR, if so directed by the ENGINEER.

3.05 PERMITS, AGREEMENTS, AND APPROVALS

- A. The following permits, agreements, and approvals will be required for this project:
 - 1. Erosion Sedimentation and Pollution Control Plan approval from Local Issuing Authority
 - 2. National Pollution Discharge Elimination System (NPDES) Construction Storm Water General Permit GAR1000001 (NOI)
 - 3. United States Army Corps of Engineers (USACE) Nationwide Permit (NWP) #27 (Aquatic Ecosystem Restoration) for the stream restoration and NWP #3 (Maintenance) for increasing the culverts sizes.
 - 4. Stream Buffer Variance from Georgia Environmental Protection Division (GA EPD)
 - 5. A Letter of Map Revision (LOMR) and possibly a Conditional Letter of Map Revision (CLOMR) may be required by the Federal Emergency Management Agency (FEMA).

END OF SECTION

(PERMITS AND AGREEMENTS FOLLOW THIS SECTION)

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SECTION 01015

CONSTRUCTION SEQUENCE

PART 1 - GENERAL

1.01 INTRODUCTION

- A. Requirements of this section shall take precedence over any other differing requirements of the Contract Documents.
- B. The herein specified list of sequence and construction constraints that CONTRACTOR shall comply with in developing his/her overall plan of construction does not release CONTRACTOR from the responsibility to coordinate the work in any manner that will ensure project completion within the time allowed.

1.02 SITE CONDITIONS

- A. Several areas of construction under this contract must be coordinated with operations personnel and ENGINEER and accomplished in a logical order to allow construction to be completed within the time allowed by Contract Documents. CONTRACTOR will also coordinate his activities with the other Contractors, if any, to allow orderly and timely completion of all the work.
- B. When access through construction areas must be disrupted, CONTRACTOR will provide alternate acceptable access for citizens, County staff and other Contractors.
- C. CONTRACTOR is required to coordinate his activities in the interface or common areas with other contractors and the public. CONTRACTOR must submit to the ENGINEER a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other Contractors, City staff, and the public.
- D. When the work requires an existing facility to be taken out of operation, temporarily or permanently, CONTRACTOR shall notify the ENGINEER and concerned parties one week in advance.

- E. CONTRACTOR shall obtain water during construction from hydrants in the vicinity of the construction area. The CONTRACTOR shall obtain a water meter from the City of Griffin. The water will be metered and any fees associated with the use of water services shall be paid by the CONTRACTOR.
- F. During Testing, CONTRACTOR shall make available the equipment, and workforce required to properly operate the equipment, and make any necessary adjustments.

1.03 CONSTRUCTION CONSTRAINTS

A. General – All Areas of Work

1. CONTRACTOR shall perform the work within the limits indicated on the plans. Any damage outside the limits of the plans shall be repaired immediately and at the CONTRACTOR'S expense.
2. Prepare and submit to the ENGINEER for review 30 days prior to start of work within roads a Maintenance of Traffic (MOT) plan. The MOT plan shall meet the detour route requirements at a minimum.
3. Install all sediment and erosion control measures as called for in the Contract Documents prior to start of all other work.
4. CONTRACTOR may use multiple crews, as required, to complete the work.
5. Provide continuous drivable access to all private properties. While construction activities are directly in front of a private property, pedestrian access must be maintained.
6. Provide continuous emergency vehicle (fire engines, ambulance, police, etc.) and school bus access at all times.
7. Provide for continuous means of access (mail, newspaper, trash pickup, etc.) at all times. CONTRACTOR will coordinate with the companies and agencies involved. CONTRACTOR may establish temporary means for mail delivery within 100 feet of private properties and coordinate with the U.S. Post Office for acceptable modified deliveries.
8. Duration of open trenches shall be minimized. ENGINEER may direct the CONTRACTOR on sequencing of work to accomplish this requirement and the CONTRACTOR shall comply at no additional cost to the OWNER. CONTRACTOR is responsible for all safety measures.

9. CONTRACTOR shall limit the length of time that private vehicles are unable to access driveways and garages to no more than three (3) calendar days. ENGINEER may direct the CONTRACTOR on sequencing of work to accomplish this requirement, and the CONTRACTOR shall comply at no additional cost to the OWNER. Private property owners shall be able to park vehicles within 100 feet of their driveways at all times.
10. Protect all trees, shrubs, and landscape improvements outside the limits of the R-O-W and where called for on the Drawings within the R-O-W. Protect tree limbs and roots extending into the R-O-W where possible. CONTRACTOR shall employ the services of a qualified, licensed horticulturalist/arborist and shall submit for the ENGINEER'S review a landscape protection plan prepared by the horticulturalist/arborist meeting all the requirements specified or shown on the Drawings.

B. Tie-Ins

1. The CONTRACTOR shall coordinate with the City all system connection work a minimum of 48-hours in advance. The CONTRACTOR shall work with the City to limit discharge of any sanitary sewer.

1.04 CLEARING, DEMOLITION, AND RESTORATION

- A. The location of the City R-O-W shall be established by the CONTRACTOR'S surveyor as per Section 01050. CONTRACTOR may clear and demolish all above-ground existing improvements within the limits of the established R-O-W as required to perform the work. Protect all improvements outside the limits of the R-O-W, as required. CONTRACTOR shall coordinate with property owners to protect existing improvements outside the R-O-W as required.
- B. Sediment and erosion control features shall be established before clearing and/or grubbing begins in any area. Placement of sediment and erosion control features will be included in the construction schedule prepared by the CONTRACTOR.

- C. Prior to construction, CONTRACTOR shall provide each private property owner written 30-day notice to allow for removal of private property within the R-O-W by the property owner. Coordinate with OWNER on content of written notice. This notification does not relieve the CONTRACTOR from responsibility for removal of any improvements not removed by the property owners necessary to perform the work.
- D. Improvements, with exception of utilities, within the R-O-W removed or relocated for construction shall not be restored, except as specifically indicated below.
- E. Immediately upon completion of the work in any area, CONTRACTOR shall restore the following, if required to be removed for construction within the limits of R-O-W:
 - 1. Fencing: Replace fencing within the R-O-W to match existing fencing.
 - 2. Irrigation: Replace all irrigation systems to match existing including, but not limited to, pipe type and size; head style, manufacturer, and location; and correct zoning. Modifications or substitutions must be approved by the property owner.
 - 3. Seeding or Sod: Seed or sod to match existing at locations not specifically indicated on the construction plans. If the exact grass type is not known, the CONTRACTOR must submit a visual sample of the proposed replacement grass to the homeowner within 30 days of the expected date of grass replacement. If the CONTRACTOR receives no written approval from the homeowner within five (5) days of the expected date of grass replacement, then the CONTRACTOR can proceed with matching as closely as possible the existing grass.
 - 4. Driveways: Replace all driveways, including any associated drainage work, control joints, concrete thicknesses, and driveway accents including, but not limited to, brick pavers to match existing driveway to the fullest extent possible. The CONTRACTOR shall work with the homeowners to incorporate any transition features (i.e., brick paver bands) between the existing driveway and the new driveway. Transition features desired by the property owner are the responsibility of the property owner and shall not delay the CONTRACTOR. A 30-day written notice from the CONTRACTOR to the property owner is required to allow the property owner adequate time to perform any desired transition features.
 - 5. Mail boxes: Mail boxes damaged or removed in completing the work shall be replaced to match existing.

6. Retaining Walls: Retaining walls damaged or removed in completing the work shall be replaced to match existing.
 7. Landscape Features: Replace landscaping features including shrubs, trees and planters within the R-O-W to match existing features, but not limited to type and size. Retaining walls damaged or removed in completing the work shall be replaced to match existing.
 8. CONTRACTOR shall coordinate with property owners regarding restoration work for seeding, sod, irrigation systems, invisible fencing, driveways, and sidewalks.
- F. Temporary seeding, or other ENGINEER approved measures for erosion control, shall be provided in all disturbed areas where work will not proceed for two (2) weeks or which are not being used for construction traffic lane.

1.05 CLEANUP

- A. During the course of the work, the CONTRACTOR shall keep the site of his operations in as clean and neat a condition as is possible. He shall dispose of all residue resulting from the construction work and, at the conclusion of the work, he shall remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operation, and shall leave the entire site of the work in a neat and orderly condition.

1.06 CONTRACTOR'S RESPONSIBILITY TO SUPPLY MATERIALS AND PERFORM WORK AT HIS EXPENSE

- A. An attempt has been made while writing this Specification to state the CONTRACTOR'S responsibilities for supplying materials and performing work under this Contract. All supply of materials and performance of work stated or implied to be the CONTRACTOR'S responsibility shall be supplied and/or performed by the CONTRACTOR and all costs in connection therewith shall be included in the unit and/or lump sum prices established under the items in the Schedule of Values.

1.07 PUBLIC NOTIFICATION

- A. The CONTRACTOR shall provide information to the OWNER to assist with the OWNER'S public notification efforts, including proposed schedule, contact information, and an emergency telephone number for contacting the CONTRACTOR'S project manager and superintendent at all times. Deviations to the proposed schedule must be approved by the OWNER and if the changes are deemed significant, the OWNER shall request that the CONTRACTOR re-issue a notification to all residences, property owners, and businesses affected by the change at no additional cost to the OWNER. Two (2) weeks before the start of work in each area the CONTRACTOR shall place a notice at the front door of each residence in that area advising the homeowners of the current schedule and again advising of the CONTRACTOR'S emergency telephone number. The text of the notices shall be approved by the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01040

COORDINATION

PART 1 - GENERAL

1.01 COORDINATION OF THE WORK

The CONTRACTOR shall coordinate the work of all the crafts, trades and Subcontractors engaged on the Work, and he shall have final responsibility as regards the schedule, workmanship and completeness of each and all parts of the Work.

All crafts, trades and Subcontractors shall be made to cooperate with each other and with others as they may be involved in the installation of work which adjoins, incorporates, precedes or follows the work of another. It shall be the CONTRACTOR'S responsibility to point out areas of cooperation prior to the execution of subcontract agreements and the assignment of the parts of the Work. Each craft, trade and Subcontractor shall be made responsible to the OWNER, for furnishing embedded items, giving directions for doing all cutting and fitting, making all provisions for accommodating the Work, and for protecting, patching, repairing and cleaning as required to satisfactorily perform the Work.

The CONTRACTOR shall be responsible for all cutting, digging and other action of his Subcontractors and workmen. Where such action impairs the safety or function of any structure or component of the Project, the CONTRACTOR shall make such repairs, alterations and additions as will, in the opinion of the ENGINEER, bring said structure or component back to its original design condition at no additional cost to the OWNER.

Each Subcontractor is expected to be familiar with the General Requirements and all sections of the Detailed Specifications for all other trades and to study all Drawings applicable to his work to the end that complete coordination between trades will be affected. Each Contractor shall consult with the ENGINEER if conflicts exist on the Drawings.

END OF SECTION

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SECTION 01046

CONTROL OF WORK

PART 1 - GENERAL

1.01 WORK FORCE

- A. Furnish personnel and equipment which will be efficient, appropriate, and large enough to secure a satisfactory quality of work and a rate of progress which will ensure completion of the Work within the Contract Time.
- B. If, at any time, such personnel and equipment appears to the ENGINEER to be inefficient, inappropriate, or insufficient for securing the quality of work required or for producing the aforesaid rate of progress, ENGINEER may order an increase in the efficiency, change in the character, or increase in the personnel and equipment; and CONTRACTOR shall conform to such order. Failure of the ENGINEER to give such order shall in no way relieve the CONTRACTOR of his/her obligations to secure the quality of the Work and rate of progress required.
- C. CONTRACTOR may use multiple crews during construction as required to complete the work within the construction period specified.

1.02 PRIVATE LAND/ROADS

- A. CONTRACTOR shall not enter or occupy private property or roads outside of easements, except by written permission of the property owner or as otherwise specified.

1.03 PIPE LOCATIONS

- A. Pipelines shall be located substantially as indicated on the Drawings, but ENGINEER reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons.
- B. Where fittings are noted on the Drawings, such notation is for CONTRACTOR'S convenience and does not relieve CONTRACTOR from laying and jointing different or additional items where required.

1.04 OPEN EXCAVATIONS

- A. All open excavations shall be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons and damage to property and shall meet all OSHA and other regulatory requirements. CONTRACTOR shall, at his own expense, provide continuous, suitable, and safe walkways for accommodating travel by pedestrians and workmen at all times during construction.

Walkways provided for access to private property during construction shall be removed when no longer required. Walkways to private properties shall be in accordance with ADA requirements. The length of an open trench will be controlled by the particular surrounding conditions, but the length shall be minimized and shall always be confined to the limits prescribed by the ENGINEER. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the ENGINEER may require special construction procedures such as limiting the length of open trench, prohibiting stacking excavated materials in the street R-O-W, and requiring that the trench shall not remain open overnight.

- B. Take precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles that could be dangerous to the public shall be well identified.
- C. Open trenches and stockpiles shall be temporarily fenced or enclosed using other means acceptable to the ENGINEER during nonworking hours and periods of construction.

1.05 OPEN TEST PITS

- A. Test pits for locating underground utilities or structures in advance of the construction shall be excavated and backfilled in accordance with Section 02200. Test pit locations shall be as acceptable to the ENGINEER. Test pits shall be backfilled immediately after their purpose has been satisfied and the surface shall be restored and maintained to original conditions.

1.06 CARE AND PROTECTION OF PROPERTY

- A. CONTRACTOR shall preserve and protect all public and private property and use every precaution necessary to prevent damage thereto, except as otherwise specified. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, such property shall be restored to a condition equal or superior to that existing before the damage was done.

1.07 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

- A. CONTRACTOR shall assume and maintain full responsibility for the protection of all buildings, structures, and utilities—public or private—including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings, except as otherwise specified. All such structures and utilities shall be carefully supported and protected from injury of any kind. Any damage shall be repaired at no expense to OWNER.

- B. CONTRACTOR shall bear full responsibility for obtaining locations of underground structures and utilities (including existing power, telephone, water services, drain lines, cable, gas, sewers, etc.). Services to buildings and structures shall be maintained, and all costs or charges resulting from damage thereto shall be paid by CONTRACTOR.
- C. Notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays, and legal holidays) before excavating in any public way.

1.08 CLEANUP AND DISPOSAL OF EXCESS MATERIALS

- A. During the course of the work, site shall be maintained in as clean and neat a condition as possible. CONTRACTOR shall dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures, and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.
- B. In order to prevent environmental pollution arising from construction activities related to the performance of this Contract, CONTRACTOR shall comply with all applicable federal, state, and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this section and elsewhere in the Specifications.
- C. Disposal of excess excavated materials in wetlands, stream corridors, and plains is strictly prohibited, even if the permission of the property owner is obtained. Any violation of this restriction will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The CONTRACTOR will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

1.09 COOPERATION WITHIN THIS CONTRACT

- A. All firms or persons authorized to perform any work under this Contract shall cooperate with each CONTRACTOR and his/her Subcontractors or trades and shall assist in incorporating the work of other trades where necessary or required.
- B. Cutting and patching, drilling, and fitting shall be carried out where required by the trade or subcontractor having jurisdiction for the work, unless otherwise specified herein or as directed by ENGINEER.

1.10 DUST CONTROL

- A. CONTRACTOR shall provide dust control in areas of work via watering trucks and sweeping for work in roadways or other means acceptable to ENGINEER in a frequency of no less than twice per work day.

1.11 SUPPLY OF WATER FOR TESTING AND DISINFECTION

- A. The OWNER will supply at no cost to the CONTRACTOR a maximum quantity of water for testing purposes equal to 200-percent (200%) of the volume of the pipe section to be tested. Additional water required will be provided at the OWNER'S standard rates for the volume required. The CONTRACTOR will coordinate closely with the OWNER to identify the source of test water, and allowable withdrawal rates. The OWNER reserves the right to restrict or disallow withdrawal of water should system conditions require.
- B. The OWNER's water may be obtained from fire hydrants at a maximum rate of 500 gpm unless otherwise approved for specific locations. The CONTRACTOR shall provide an OWNER approved reduced-pressure backflow preventer and water meter at the hydrant or other connection point and all the necessary piping, valves, hoses, pumps, and appurtenances to make the connections and properly fill and disinfect all features to be in contact with potable water. The CONTRACTOR shall submit the proposed filling system and disinfection equipment to the ENGINEER for prior approval at least 4 weeks in advance of the proposed testing. All work shall be scrupulously sanitary and no introduction of any contaminants into the system shall be allowed. The ENGINEER must approve the installation of the filling system prior to any connections to the existing system.

1.12 MAINTENANCE OF FLOW

- A. Provide for the flow of sewers, drains and water courses (if applicable) interrupted during the progress of the work, and immediately carry away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the ENGINEER well in advance of the interruption of any flow.

1.13 MAINTENANCE OF TRAFFIC

- A. Unless permission to close a street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the construction operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the ENGINEER.
- B. Detours around construction will be subject to the approval of the OWNER and the ENGINEER. Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic. Expedite construction operations while traffic is detoured. Periods when traffic is being detoured will be strictly controlled by the OWNER.

- C. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist or police protection provided for traffic while work is in progress. The CONTRACTOR shall be fully responsible for damage or injuries whether or not police protection has been provided.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01050

FIELD ENGINEERING AND SURVEYING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. Provide and pay for field engineering services required for Project:

1. Survey work required in execution of Project.
2. Civil, structural, or other professional engineering services specified or required to execute CONTRACTOR'S construction methods.
3. Field location of all existing utilities prior to beginning the Work. This information and any variations noted during construction shall be included on the Record Drawings.

B. Retain the services of a professional land surveyor licensed in Georgia to:

1. Identify existing control points and property line corner stakes, as required.
2. Verify all existing pipe line and structure locations.
3. Maintain an accurate location of all buried piping, utilities, and structures.
4. Establish pipeline centerline survey (horizontal and vertical) through field staking. Surveying of the water main alignment shall occur prior to clearing and grubbing activities.
5. Record the location of all fittings, valves and center line of all culverts using GPS technology as specified herein.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01015: Construction Sequence.
- C. Section 01046: Control of Work.
- D. Section 01030: Applications for Payment.
- E. Section 01100: Special Project Procedures.

F. Section 01720: Project Record Documents.

1.03 SUBMITTALS

- A. Submit to ENGINEER name and address of registered land surveyor or professional engineer.
- B. Upon request of ENGINEER, submit documentation to verify accuracy of field engineering work.
- C. Submit certificate signed by registered engineer or land surveyor certifying that elevations and locations of improvements are in conformance or nonconformance with Contract Documents.
- D. At the end of the project and prior to final payment submit certified drawings (signed and sealed by the registered land surveyor) of the items listed herein. These drawings shall be included with and made a part of the project Record Documents:
 - 1. Certified site survey at same scale as Contract Drawings, on reproducible 24- by 36-inch sheets, indicating pipe line, utilities, structures, sidewalks, paved areas, and location of all improvements. Certified site survey shall also be provided in electronic format using the latest version of Autocad.
 - 2. Certified drawings showing the location, lines, and grades of all buried piping and other buried facilities installed as a result of the work. These drawings shall be at the same scale as the ENGINEER'S Drawings and submitted on reproducible 24- by 36-inch sheets. Certified drawings shall also be provided in electronic format using the latest version of Autocad.
 - 3. Legibly mark drawings to record actual construction. The location of all valves and fittings shall be established in the field using sub-meter accuracy GPS technology. This information shall be included on the record drawings and be provided electronically to the ENGINEER for review at the same time the record drawings are submitted.

1.04 QUALIFICATIONS OF SURVEYOR OR ENGINEER

- A. Professional engineer or land surveyor of the discipline required for the specific service on the Project shall be currently licensed in Georgia.

1.05 SURVEY REFERENCE POINTS

- A. Existing basic horizontal and vertical control points for the Project shall be those designated on the drawings. Vertical control points shall be field verified prior to start of construction.
- B. Control points shall be located and protected prior to starting site work, and all permanent reference points shall be preserved during construction.
 - 1. No changes or relocations shall be made without prior written notice to ENGINEER.
 - 2. Report to ENGINEER when any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
 - 3. Require surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control. Certified horizontal and vertical position for all pipe covered by each monthly payment application shall be a prerequisite for application for payment approval. No pipe will be paid or until its correct position has been confirmed by survey.

1.06 PROJECT SURVEY REQUIREMENTS

- A. Establish a minimum of two permanent bench marks, referenced to data established by survey control points. Record locations, with horizontal and vertical data, on project Record Documents.
- B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means.
- C. From time to time, verify layouts by same methods.
- D. Establish all lines and grades prior to construction of line work for all buried piping at maximum 100-foot increments and at defined breaks in grade, unless otherwise specified.

1.07 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
- B. Update the project Record Drawings monthly, based on the work performed during the month ending with the Application for Payment date, as a condition for approval of monthly progress payment requests.
- C. Maintain an accurate record of all changes, revisions, and modifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01100

SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.01 OPERATING AND MAINTENANCE DATA

- A. Operating and maintenance data covering all equipment furnished under Division 2 shall be submitted directly to the ENGINEER for review. Four final approved copies of operating and maintenance data shall be delivered to the ENGINEER.

1.02 INSTALLATION OF EQUIPMENT

- A. Special care shall be taken to ensure proper alignment of all equipment with particular reference to mechanical equipment such as valves. The CONTRACTOR shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances, will pipe springing be allowed.
- B. All wedges, shims, filling pieces, keys, packing, red-on-white lead grout, or other materials necessary to properly align, level, and secure apparatus in place shall be furnished by the CONTRACTOR. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper bearing after erection shall be done at the expense of the CONTRACTOR.

1.03 SLEEVES AND OPENINGS

- A. The CONTRACTOR shall provide all openings, channels, chases, etc., and install anchor bolts and other items to be embedded in concrete, as required to complete the work under this Contract, together with those required by Subcontractors, and shall do all cutting and patching, excepting cutting and patching of materials of a specified trade and as stated otherwise..
- B. In no case shall structural members be cut without the approval of the ENGINEER.

1.04 RELOCATIONS

- A. CONTRACTOR shall be responsible for the relocation or temporary support of structures including, but not limited to, light poles, signs, sign poles, fences, piping, conduits, and drains that interfere with the positioning of the work as indicated on the Drawings. The cost of all such relocations shall be included in the Bid prices for the project and shall not result in any additional cost to the OWNER.

1.05 OBSTRUCTIONS

- A. Attention is drawn to the fact that during excavation at the Project site, the possibility exists of encountering various utilities or other lines not shown on the Drawings. Extreme care shall be exercised before and during excavation to locate and flag all utilities so as to avoid damage to the existing utilities. Should damage occur to an existing utility, CONTRACTOR shall assume full responsibility for affecting the repair in accordance with the utility's requirements at no cost to the OWNER.
- B. All utility or other poles, the stability of which may be endangered by the close proximity of excavation, shall be temporarily stayed in position while work proceeds in the vicinity of the pole. The utility or other companies concerned shall be given reasonable advance notice of any such excavation.

1.06 PROVISIONS FOR CONTROL OF EROSION

- A. Sufficient precautions in accordance with Section 02270 shall be taken during construction to minimize runoff of polluting substances such as silt, clay, fuels, oils, bitumens, calcium chloride, or other polluting materials harmful to humans, fish, or other life into the supplies and surface waters of the State. Control measures shall be adequate to assure that turbidity in the receiving water will not be increased more than the limits established by the State or other controlling body in water used for public water supply or fish. In surface water used for other purposes, the turbidity shall not exceed the limits established by the State, unless otherwise permitted. Special precautions shall be taken in the use of construction equipment to prevent operations which promote erosion.
- B. Erosion and sedimentation control shall conform to the requirements of the State of Georgia Erosion and Sedimentation Control Act of 1975 with all current amendments.

1.07 VALVE INDICES

- A. Furnish and install tags for all valves required on the Work. Buried valve tags shall be secured to a concrete base or valve box. Above-ground or vault valve tags shall be furnished with noncorrosive metal wire for attachment thereof. Tags shall not be attached to handwheel or crank operators or any part of the valve which would inhibit operation of the valve. Submit to the ENGINEER for review, two samples of each type of tag proposed and the manufacturer's standard color chart and letter styles. Tags shall have stamped or engraved on them the information shown on the Drawings and the data described herein.

1.08 ONSITE STORAGE

- A. The CONTRACTOR'S attention is invited to special storage requirements and possible charges for noncompliance of onsite storage requirements for materials and equipment as specified in Section 01600. All piping, valves, equipment, motors, etc., shall be stored as per the Specifications and according to the manufacturers' recommendations.

1.09 CONNECTIONS TO EXISTING SYSTEMS

- A. Perform all work necessary to locate, excavate, and connect to existing systems as shown on the Drawings.
- B. Expose and determine size, type, and material of connection before submittal of shop drawings. Shop drawings shall show all connections and include any special adapters required to make the connections.

1.10 UTILITY CROSSINGS

- A. It is intended that existing utilities that must be crossed will be relocated as indicated on the Drawings. However, when, in the opinion of the OWNER or ENGINEER, this procedure is not feasible, CONTRACTOR may be directed to use fittings for a utility crossing as detailed on the Drawings.
- B. All utility crossing clearances shall meet local, state, and federal requirements.

1.11 EXISTING UTILITY PROTECTION

- A. Existing utilities are shown in their approximate locations. Locate and protect all utilities whether shown on the Drawings or not.
- B. Contact utility companies at least 48 hours before starting construction, so maintenance personnel can locate and protect facilities, if required by the utility company.
- C. CONTRACTOR shall pay for any required utility relocation.

1.12 ARCHEOLOGICAL FINDS

- A. Notwithstanding anything to the contrary herein, in the event any archeological artifacts are discovered within the project during the course of the Work, the OWNER shall have and retain all right, title, and interest to such artifacts and shall have the further right, during the course of the Contract, to examine or cause to have examined, the site of the Work for any such artifacts and to perform or have performed archeological excavations and all other related work to explore for, discover, recover, and remove such artifacts from the site of the Work.
- B. In the event the archeological examination or related work delays the CONTRACTOR'S work, CONTRACTOR shall be entitled to an extension of time to complete the work equal to the number of days CONTRACTOR is thus delayed. Such delay shall be considered a noncompensable excusable delay as defined in the Supplementary Conditions.

1.13 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as to eliminate direct contact and any resulting electrolysis.
- B. The insulating material shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other approved materials.

1.14 WEATHER PROTECTION

- A. In the event of inclement weather, the CONTRACTOR and Subcontractors shall protect the Work and materials from damage or injury from the weather. If, in the opinion of the ENGINEER, any portion of the Work or materials has been damaged by reason of failure on the part of the CONTRACTOR or subcontractors to so protect the Work, such Work and materials shall be removed and replaced with new materials and Work to the satisfaction of the ENGINEER.
- B. CONTRACTOR shall hold himself responsible for all damage done to the work by heavy rains and shall take all reasonable precautions to provide against damages by building such temporary dikes, channels, or shoring to carry off storm water as the nature of the work may require.

1.15 TOOLS

- A. Any special tools (including grease guns or other lubricating devices, if required) which may be necessary for the adjustment, operation, and maintenance of any equipment shall be furnished with the respective equipment.

1.16 GREASE, OIL, FUEL, ELECTRICAL POWER, AND TESTING EQUIPMENT

- A. All grease, oil, and fuel required for testing of equipment shall be furnished with the respective equipment. Electric power and all equipment and tools required for testing of equipment shall be furnished by the CONTRACTOR, the cost of which shall be included in the prices quoted in the Bid Form.
- B. The OWNER shall be furnished with a 1-year supply of required lubricants, including grease and oil of the type recommended by the manufacturer, with each item of equipment supplied under Division 2.

1.17 EMERGENCY PHONE NUMBERS AND ACCIDENT REPORTS

- A. Emergency phone numbers (fire, medical, and police) shall be available with the CONTRACTOR.
- B. Accidents shall be reported immediately to the ENGINEER by messenger or phone.
- C. All accidents shall be documented and a fully detailed written report submitted to the ENGINEER after each accident.

1.18 USE OF CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with the manufacturer's instructions and EPA requirements.

1.19 SPARE PARTS

- A. Where spare parts are specified in the various sections of the Specifications, furnish all spare parts recommended by the manufacturer or system supplier for 1 year of service. In addition, furnish all spare parts itemized in each section of the Specification.
- B. Collect and store all spare parts in an area to be designated by the ENGINEER. Furnish the ENGINEER with an inventory listing all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.
- C. Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for 1 year of storage.
- D. Spare parts shall be delivered to the OWNER not later than 10 days prior to startup.

1.20 CONTRACTOR'S DAILY REPORTS

- A. The CONTRACTOR shall submit daily reports of construction activities, including non-work days. The report shall include:
 - 1. Manpower, number of men by craft
 - 2. Equipment on the project
 - 3. Major deliveries
 - 4. Activities work with reference to the CPM schedule activity numbers
 - 5. New problems
 - 6. Other pertinent information
- B. A similar report shall be submitted for/by each subcontractor.
- C. The reports shall be submitted to the ENGINEER'S Field Office within 2 days of the respective report date. Each report shall be signed by the CONTRACTOR'S Superintendent or Project Manager.
- D. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents. Notice shall be as required therein.
- E. CONTRACTOR'S daily reports shall be submitted on the Quality Control Daily Report form specified in Section 01450 and shall include all necessary attachments and continuation sheets to provide the required information.

1.21 BOLTS, ANCHOR BOLTS, AND NUTS

- A. Furnish all bolts, anchor bolts, nuts, washers, plates, and bolt sleeves required to perform the work.
- B. Furnish expansion bolts with malleable iron and lead composition elements.
- C. Unless otherwise specified, stud, tap, and machine bolts and nuts shall conform to the requirements of ASTM A307. Use hexagonal nuts of the same quality of metal as the bolts. Threads shall be clean cut and shall conform to ANSI B1.1.
- D. Anchor bolts, nuts, and washers shall be Type 316 stainless steel, unless otherwise specified.

- E. Bolts, nuts, and washers submerged or subject to splashing shall be Type 316 stainless steel.
- F. Where specified to be galvanized, bolts, anchor bolts, nuts, and washers shall be zinc coated, after being threaded, by the hot-dip process in accordance with ASTM A153.

1.22 FINAL GUARANTEE

- A. All work shall be guaranteed by the CONTRACTOR for a period of 1 year from and after granting Substantial Completion of the work by the OWNER.
- B. If, within the guarantee period, repairs or changes are required in connection with guaranteed work which, in the opinion of the ENGINEER, is rendered necessary as the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract, the CONTRACTOR shall, promptly, upon receipt of notice from the OWNER and without expense to the OWNER, do the following.
 - 1. Place in satisfactory condition in every particular all of such guaranteed work and correct all defects therein.
 - 2. Make good all damage to the building or site or equipment or contents thereof which, in the opinion of the ENGINEER, is the result of the use of materials, equipment, or workmanship which are inferior, defective, or not in accordance with the terms of the Contract.
 - 3. Make good any work or material, equipment or contents of building, structure, or site disturbed in fulfilling any such guarantee.
- C. If the CONTRACTOR, after notice, fails within 10 days to proceed to comply with the terms of this guarantee, the OWNER may have the defects corrected, and the CONTRACTOR and his/her Surety shall be liable for all expenses incurred, provided, however, that in case of an emergency where, in the opinion of the OWNER, delay would cause loss or damage, repairs may be started without notice being given to the CONTRACTOR and the CONTRACTOR shall pay the cost thereof.
- D. All special guarantees or warranties applicable to specific parts of the work as may be stipulated in the Contract Specifications or other papers forming a part of this Contract shall be subject to the terms of this paragraph during the first year of life of each such guarantee. All special guarantees and manufacturers' warranties shall be assembled by the CONTRACTOR and delivered to the ENGINEER, along with a summary list thereof, before the acceptance of the Work.

1.23 MAINTENANCE OF EXISTING UTILITY SERVICE AND OPERATION

- A. The CONTRACTOR shall fully cooperate at all times with the OWNER in order to maintain water system operation with the least amount of interference and interruption possible. Public health and safety considerations shall exceed all others and the CONTRACTOR'S schedule, plan, and work shall, at all times, be subject to alteration and revision, if necessary, for public health and safety considerations.
- B. CONTRACTOR shall take whatever precautions are necessary to maintain the flow of sewers to keep the sewer system in operation, where such operation is affected by the CONTRACTOR work. All tie-in work requiring a shutdown of an existing gravity sewer system shall require detailed schedule submittals and coordination meetings in advance of the proposed work as specified herein.
- C. In no case will the CONTRACTOR be permitted to interfere with any existing service until all materials, supplies, equipment, tools, and incidentals necessary to complete the work are on the job site.
- D. The ENGINEER and the OWNER reserve the right to require the CONTRACTOR to work 24 hours per day in all cases where interferences with existing utility service may result in health hazards, offensive conditions, or serious inconveniences to persons served by the system.
- E. Thirty (30) days prior to any interference with existing pipes, the CONTRACTOR shall submit to the ENGINEER the CONTRACTOR'S proposed method for maintaining service. The submittal shall include text and drawings in sufficient detail to describe the method, a list of equipment to be used, and a schedule for completing the work. No interference with service shall be made until the ENGINEER approves the CONTRACTOR'S method and schedule for completing the work.

1.24 PRECONSTRUCTION DVD

- A. Prior to commencement of any construction activity the CONTRACTOR shall create and deliver to the ENGINEER a DVD showing the condition of the site prior to construction activity. The DVD and audio commentary shall be completed according to the requirements of Section 01390.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01110

ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish all labor, materials, and equipment and perform all work required for the prevention of environmental pollution in conformance with applicable laws and regulations, during and as the result of construction operations under this Contract. For the purpose of this section, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires consideration of air, water, and land and involves management of noise and solid waste, as well as other pollutants.
- C. Schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the work. Provide erosion control measures such as diversion channels, sedimentation or filtration systems, berms, staked hay bales, seeding, mulching, or other special surface treatments as required to prevent silting and muddying of streams, rivers, impoundments, lakes, private properties, etc. All erosion control measures shall be in place in an area prior to any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 02270. All phases of sedimentation and erosion control shall comply with and be subject to the approval of State and local regulators.
- D. The Work shall be conducted with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. This section includes general guidelines for such conduct. Construction means, methods, and techniques shall be used which will result in conformance with the requirements of this section.

1.02 RELATED REQUIREMENTS

- A. Section 02100: Site Preparation.
- B. Section 02200: Earthwork.
- C. Section 02270: Sedimentation and Erosion Control.

1.03 APPLICABLE REGULATIONS

- A. Comply with all applicable federal, state, and local laws and regulations concerning environmental pollution control and abatement.
- B. Erosion and sediment control shall conform to the requirements of the local issuing authority for the State of Georgia.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 IMPLEMENTATION

- A. Prior to beginning the Work, CONTRACTOR shall meet with OWNER and ENGINEER to develop mutual understandings relative to the administration of environmental pollution control procedures and compliance with the provisions of this section.
- B. Ensure compliance by subcontractors.
- C. Remove temporary environmental control features and incorporate permanent control features into the Work at the earliest practicable time.

3.02 NOTIFICATIONS

- A. The ENGINEER will notify the CONTRACTOR in writing of any noncompliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. Federal, state or local agencies responsible for verification of certain aspects of the environmental protection requirements may notify the CONTRACTOR in writing of any noncompliance with federal, state or local requirements. After receipt of any such notice from the ENGINEER or from the regulatory agency, immediately take corrective action.
- B. Delivery of notices to the site of the Work shall be deemed sufficient for the purpose of formal notification.
- C. Failure or refusal to comply promptly with notifications may result in the OWNER's issuance of an order to stop all or part of the Work until satisfactory corrective action has been taken. No changes to the Contract Time or Price due to such stop work orders will be made unless it is subsequently determined that the CONTRACTOR was in compliance with all requirements.

3.03 EROSION CONTROL

- A. Provide positive means of erosion control as shown on the Drawings. Erosion control measures shall be used as appropriate and as specified in Section 02270. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. At the completion of the work, ditches shall be backfilled and the ground surface restored to original condition.

3.04 PROTECTION OF STREAMS AND SURFACE WATERS

- A. Care shall be taken to prevent or reduce to a minimum any damage to any stream and surface waters from pollution by debris, sediment, or other material or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing or that contains oils or sediments that will reduce the quality of the water in the stream shall not be directly returned to the stream. Such waters will be diverted through a settling basin or filter before being directed into the streams or surface waters.
- B. Do not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.
- C. Take all preventative measures to avoid spillage of petroleum products and other pollutants. On-site storage of diesel fuel (or other petroleum products) shall be within a concrete containment vessel. The containment area shall be a minimum of 125-percent (125%) of the volume of the storage tank. In the event of any spillage, prompt remedial action shall be taken.
- D. Water being flushed from structures or pipelines after disinfection, with a Cl₂ residual of 2 mg/l or greater shall be treated with a dechlorination solution, in a method approved by the ENGINEER, prior to discharge.

3.05 PROTECTION OF LAND RESOURCES

- A. Land resources within the project boundaries and outside the limits of permanent work shall be restored to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.
- B. Outside of the project site do not deface, injure, or destroy trees or shrubs nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage, unless specifically authorized by ENGINEER and the property owner.

- C. Where trees outside the project site may possibly be defaced, bruised, injured, or otherwise damaged by construction equipment, dumping, or other operations, protect such trees by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly before beginning operations near them.

- D. Any trees or other landscape feature outside the project site scarred or damaged by construction equipment or operations shall be restored as nearly as possible to its original condition. The ENGINEER shall decide what method of restoration shall be used and whether damaged trees shall be treated and healed or removed and disposed of.
 - 1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1 inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
 - 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged and are beyond saving, in the opinion of the ENGINEER, shall be immediately removed and replaced.

- E. The locations of storage and other construction buildings, required temporarily in the performance of the Work, shall be on cleared portions of the job site, or areas to be cleared as shown on the Drawings; shall require written approval of the ENGINEER; and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the ENGINEER.

- F. If temporary roads or embankments and excavations for plant and/or work areas are necessary, submit the following for approval at least 10 calendar days prior to scheduled start of such temporary work.
 - 1. A layout of all temporary roads, excavations, and embankments to be constructed within the work area.
 - 2. Details of temporary road construction.
 - 3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.

4. A landscaping drawing showing the proposed restoration of the area. Removal of any trees and shrubs outside the limits of existing clearing area shall be indicated. The drawing shall also indicate location of required guard posts or barriers required to control vehicular traffic passing close to trees and shrubs to be maintained undamaged. The drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of approved drawings shall be made only with the written approval of the ENGINEER. No unauthorized road construction, excavation, or embankment construction, including disposal areas, will be permitted.
- G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles or excess of waste materials, or any other vestiges of construction as directed. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded or sodded as described in Section 02900.
- H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.06 PROTECTION OF AIR QUALITY

- A. Burning: The use of burning at the project site for disposal of refuse and debris shall not be permitted.
- B. Dust Control: Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the ENGINEER.
- D. Sprinkling shall be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times. Maintain sufficient, competent equipment on the job to accomplish this if sprinkling is used. Dust control shall be performed as the work proceeds whenever a dust nuisance or hazard occurs or when directed by the ENGINEER.

3.07 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

- A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.08 NOISE CONTROL

- A. Construction equipment shall be equipped with silencers or mufflers designed to operate with the lowest possible noise levels.
- B. Comply with local noise control ordinances.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, and Samples. Detailed submittal requirements will be specified in the technical sections.
- B. All submittals shall be clearly identified by reference to Section Number, Paragraph, Drawing Number, or Detail as applicable. Submittals shall be clear and legible and of sufficient size for sufficient presentation of data.

1.02 SHOP DRAWINGS, PRODUCT DATA, SAMPLES

A. Shop Drawings

1. Shop drawings, as defined in the General Conditions and as specified in individual work sections, may include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shopwork manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection, and test reports including performance curves and certifications, as applicable to the work.
2. All shop drawings submitted by subcontractors, manufacturers, and suppliers for approval shall be submitted directly to the CONTRACTOR for checking. The CONTRACTOR shall be responsible for their submission at the proper time so as to prevent delays in delivery of materials.
3. CONTRACTOR shall check all shop drawings regarding measurements, size of members, materials, and details to make sure that they conform to the intent of the Drawings and related Specification sections. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractors for correction before submission thereof.
4. All details on shop drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure; and, where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted for approval.

5. The CONTRACTOR'S certification stamp and all markings by CONTRACTOR shall be in the color green. The ENGINEER reserves the use of the color red for ENGINEER'S review stamp and all ENGINEER'S marks.
6. The CONTRACTOR shall identify any and all proposed deviations on the shop drawing submittals. Approved shop drawings which fail to call out deviations from Contract Document requirements do not relieve the CONTRACTOR from meeting said requirements.

B. Product Data

1. Product data, as specified in individual sections, include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare parts listing and printed product warranties, as applicable to the work.

C. Samples

1. Samples, as specified in individual sections, include, but are not necessarily limited to, physical examples of the work such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols, and units of work to be used by the ENGINEER or OWNER for independent inspection and testing, as applicable to the work.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following:
 1. Field measurements
 2. Field construction criteria
 3. Catalog numbers and similar data
 4. Conformance with related sections
- B. The CONTRACTOR shall review and check submittals, and shall indicate his review by initials and date.

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

- C. Shop drawings and product data sheets 11 x 17 inches and smaller shall be bound together in an orderly fashion and bear the above Certification Statement on the cover sheet. The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the Resident Project Representative (RPR) a copy of each transmittal sheet for shop drawings, product data, and samples at the time of submittal to the ENGINEER.
- D. A 10-character submittal identification numbering system shall be used in the following manner:
 - 1. The first character shall be a D, S, P, M, or R, which represents Shop/Working Drawing and other Product Data (D), Sample (S), Preliminary Submittal (P), Operating/ Maintenance Manual (M), or Request for Information (R).
 - 2. The next 5 digits shall be the applicable Specification section number.
 - 3. The next 3 digits shall be the numbers 001 to 999 to sequentially number each initial separate item or drawing submitted under each specific section number.
 - 4. The last character shall be a letter, A to Z, indicating the submission, or resubmission of the same Drawing, i.e., “A=1st submission, B=2nd submission, C=3rd submission, etc.
 - 5. A typical submittal number would be as follows:

D-03300-008-B

D = Shop Drawing
03300 = Section for Concrete
008 = The eighth initial submittal under this section
B = The second submission (first resubmission) of that particular shop drawing

- E. Notify the ENGINEER in writing at the time of submittal of any deviations in the submittals from the requirements of the Contract Documents.

- F. The review and approval of shop drawings, samples, or product data by the ENGINEER shall not relieve the CONTRACTOR from his/her responsibility with regard to the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the CONTRACTOR, and the ENGINEER will have no responsibility therefor.
- G. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased, or on-site construction accomplished which does not conform to approved shop drawings and product data shall be at the CONTRACTOR'S risk. The OWNER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- H. Project work, materials, fabrication, and installation shall conform with approved shop drawings, applicable samples, and product data.

1.04 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved construction schedules and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities or within the time specified in the individual work of other related sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery, and similar sequenced activities. No extension of time will be authorized because of the CONTRACTOR'S failure to transmit submittals sufficiently in advance of the Work.
- C. All submittals shall be made sufficiently in advance of construction requirements to provide no less than 21 calendar days from the time the ENGINEER receives them for review. Up to 30 calendar days may be required for major equipment items or submittals which require review by more than one engineering discipline. The first submittal for all items shall be made within 45 days of the Notice to Proceed.
- D. Number of submittals required:
 - 1. Shop Drawings as defined in Paragraph 1.02A: Five (5) copies for use by OWNER and ENGINEER, plus the number of copies to be returned to CONTRACTOR (maximum total of nine).
 - 2. Product Data as defined in Paragraph 1.02B: Five (5) copies for use by OWNER and ENGINEER, plus the number of copies to be returned to CONTRACTOR (maximum total of nine).
 - 3. Samples: Submit the number stated in the respective Sections.

E. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.
2. The Project title and number.
3. CONTRACTOR identification.
4. The names of:
 - a. CONTRACTOR
 - b. Supplier
 - c. Manufacturer
5. Identification of the product, with the section number, page, and paragraph(s).
6. Field dimensions, clearly identified as such.
7. Relation to adjacent or critical features of the work or materials.
8. Applicable standards, such as ASTM or Federal Standards numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8- by 3-inch blank space for CONTRACTOR and ENGINEER stamps.

1.05 REVIEW OF SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. The review of shop drawings, product data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
1. As permitting any departure from the Contract requirements.
 2. As relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials.
 3. As approving departures from details furnished by the ENGINEER, except as otherwise provided herein.

- B. The CONTRACTOR remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, product data, or samples as submitted describe variations and show a departure from the Contract requirements which ENGINEER finds to be in the interest of the OWNER and to be so minor as not to involve a change in Contract Price or time for performance, the ENGINEER may return the reviewed drawings without noting an exception.
- D. Submittals will be returned to the CONTRACTOR under one of the following codes.

Code 1 - "APPROVED" – Assigned when there are no notations or comments on the submittal. When returned under this code the CONTRACTOR may release the equipment and/or material for manufacture.

Code 2 - "APPROVED AS NOTED" – Assigned when the CONTRACTOR'S confirmation of the review notations and comments IS NOT required. The CONTRACTOR may release the equipment or material for manufacture. However, all notations and comments must be incorporated into the final product.

Code 3 - "APPROVED AS NOTED/CONFIRM" – Combination of codes assigned when CONTRACTOR IS required to confirm the review notations and comments. The CONTRACTOR may, at his/her own risk, release the equipment or material for manufacture. However, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the ENGINEER within 15 calendar days of the date of the ENGINEER'S transmittal requiring the confirmation.

Code 4 - "APPROVED AS NOTED/RESUBMIT" – Combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the ENGINEER within 15 calendar days of the date of the ENGINEER'S transmittal indicating the resubmittal requirement.

Code 5 - "NOT APPROVED" – Assigned when the submittal does not meet the intent of the Contract Documents. The CONTRACTOR must resubmit the entire package, revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.

Code 6 - “COMMENTS ATTACHED” – Assigned when there are comments attached to the returned submittal which provide additional data to aid the CONTRACTOR.

Code 7 - “FOR INFORMATION ONLY” is assigned when the submittal provides information of a general nature that may or may not require a response.

Codes 1 through 5 designate the status of the reviewed submittal with Code 6 showing there has been an attachment of additional data. Code 7 will be used as may be necessary.

- E. Resubmittals will be handled in the same manner as first submittals. On resubmittals the CONTRACTOR shall direct specific attention, in writing on the letter of transmittal and on resubmitted shop drawings and product data by use of revision triangles or other similar methods, to revisions other than the corrections requested by the ENGINEER, on previous submissions. Any such revisions which are not clearly identified shall be made at the risk of the CONTRACTOR. The CONTRACTOR shall make corrections to any work done, because of this type revision that is not in accordance to the Contract Documents as may be required by the ENGINEER.
- F. Partial submittals may not be reviewed. The ENGINEER will be the sole judge as to the completeness of a submittal. Submittals not considered complete will be returned to the CONTRACTOR and will be considered “Not Approved” until resubmitted. The ENGINEER may, at his/her option, provide a list or mark the submittal directing the CONTRACTOR to the areas that are incomplete.
- G. Repetitive Review
 - 1. Shop drawings and other submittals will be reviewed no more than twice at the OWNER’S expense. All subsequent reviews will be performed at times convenient to the ENGINEER and shall be at the CONTRACTOR’S expense, based on the ENGINEER’S then prevailing rates. The CONTRACTOR shall reimburse the OWNER for all such fees invoiced to the OWNER by the ENGINEER. Submittals are required until approved.
 - 2. Any need for more than one resubmission, or any other delay in obtaining ENGINEER’S review of submittals, will not entitle CONTRACTOR to extension of the Contract Time.
- H. If the CONTRACTOR considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the CONTRACTOR shall give written notice thereof to the ENGINEER within 30 calendar days of receipt—at least 10 working days prior to release for manufacture.
- I. When the shop drawings have been completed to the satisfaction of the ENGINEER, the CONTRACTOR shall carry out the construction in accordance therewith and shall make no further changes therein, except upon written instructions from the ENGINEER.

- J. Requests for Information (RFIs) shall be submitted on a standard form provided by the ENGINEER. RFIs shall indicate their importance to the timely completion of the project, and shall be submitted so as to provide no less than 21 calendar days for review from the time the ENGINEER receives them.

1.06 DISTRIBUTION

- A. Distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and elsewhere as directed by the ENGINEER. Number of copies shall be as directed by the ENGINEER but shall not exceed nine.

1.07 PROFESSIONAL ENGINEER (P.E.) CERTIFICATION FORM

- A. If specifically required in other Sections of these Specifications, a P.E. Certification Form shall be submitted for each item required.

1.08 SCHEDULES

- A. Provide all schedules required by the Contract Documents and elsewhere in the General Conditions.

END OF SECTION

(FORM FOLLOWS THIS SECTION)

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State Georgia and that he/she has been employed by (Name of Contractor) _____ to design _____ in accordance with Specification Section _____ of this Contract. The undersigned further certifies that he/she has performed the design of the _____, that said design is in conformance with all applicable local, State, and Federal codes, rules, and regulations, and that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in and resulting from the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the Owner or Owner's representative with 7 days following written request therefore by the Owner or Owner's representative.

P.E. Name

Signature

Address

Contractor's Name

Signature

Title

Address

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SECTION 01310

CONSTRUCTION SCHEDULE

PART 1 - GENERAL

1.01 THE REQUIREMENT

The project management scheduling tool, "Critical Path Method" commonly called CPM, shall be used by the CONTRACTOR for the planning and scheduling of all work required under the Contract Documents.

1.02 QUALIFICATIONS

The CONTRACTOR shall submit evidence of CPM capability for ENGINEER'S review.

1.03 SUBMITTAL PROCEDURES

A. Submittal Requirements

1. Logic network and/or time phased barchart, computer generated, utilizing the precedent diagram method.
2. Computerized network analysis.
 - a. Activity sort by early start, organized by related elements.
 - b. Activity sort by float, organized by related elements.
 - c. Activity sort by predecessor/successor.
3. Schedule of shop drawing submittals.
4. Schedule of values (lump sum price breakdown).

B. Time of Submittals. Within fifteen (15) working days after Notice to Proceed, CONTRACTOR shall submit a network diagram describing the activities to be accomplished in the project and their dependency relationships, (predecessor/successor) as well as a tabulated schedule as herein defined. The schedule produced and submitted shall indicate a project completion date the same as the contract completion date. The CONTRACTOR shall meet with the ENGINEER to review the proposed plan and schedule.

- C. Upon completion of his review of the submittal, the ENGINEER will return the schedule with comments. The CONTRACTOR shall revise the network diagram as required and resubmit the network diagram and a tabulated schedule produced therefrom. The revised network diagram and tabulated schedule shall be reviewed by the ENGINEER. The network diagram and tabulated schedule shall constitute the project work schedule unless a revised schedule is required due to substantial changes in the work scope, a change in contract time, or delinquency by CONTRACTOR requiring a recovery schedule. When the network diagram and tabulated schedule have been accepted.
- D. Revised Work Schedules. The CONTRACTOR, if requested by the ENGINEER, shall provide a revised work schedule. The revised work schedule shall include a new diagram and tabulated schedule designed to show how CONTRACTOR intends to accomplish the work to meet the completion date. The form and method employed by CONTRACTOR shall be the same as for the original schedule.

1.04 SCHEDULING RESPONSIBILITIES

- A. It is understood that the construction schedule and all revised information must be produced by the CONTRACTOR and that this information is a representation of the best efforts of the CONTRACTOR and his Subcontractors as to how they envision the work to be accomplished. Similarly, all progress information to be provided by and through the CONTRACTOR must be an accurate representation of his or his Subcontractor's or supplier's actual performance. The schedule shall at all times remain an accurate reflection of the CONTRACTOR'S actual or projected sequencing of the Work. Once accepted by the ENGINEER, adherence to the established CPM schedule shall be obligatory upon the CONTRACTOR and his Subcontractors for the Work under his Contract.
- B. Progress of the Work
 - 1. The Work shall be started within ten (10) days following the Notice to Proceed and shall be executed with such progress as may be required to prevent delay to the general completion of the Project. The Work shall be executed at such times and in or on such parts of the Project, and with such forces, material and equipment, to assure completion of the Work in the time established by the Contract.
 - 2. The CONTRACTOR agrees that whenever it becomes apparent from the current monthly CPM Schedule update that delays to the critical path have resulted and, hence, that the Contract completion date will not be met or when so directed by the OWNER, he will take some or all of the following actions at no additional cost to the OWNER:

- a. Increase construction manpower in such quantities and crafts as will substantially eliminate the backlog of work.
- b. Increase the number of working hours per shift, shifts per working day or days per week, the amount of construction equipment, or any combination of the foregoing to substantially eliminate the backlog of work.
- c. Reschedule activities to achieve maximum practical concurrence of accomplishment of activities, and comply with the revised schedule.
- d. The CONTRACTOR shall submit to the OWNER and the ENGINEER for review a written statement of the steps he intends to take to remove or arrest the delay to the critical path in the accepted schedule. If the CONTRACTOR should fail to submit a written statement of the steps as required by the Contract, the OWNER may direct the level of effort in manpower (trades), equipment, and work schedule (overtime, weekend and holiday work, etc.), to be employed by the CONTRACTOR in order to remove or arrest the delay to the critical path in the accepted schedule, and CONTRACTOR shall promptly provide such level of effort at no additional cost to the OWNER.
- e. From time-to-time, it may be necessary for the Contract schedule and/or completion time to be adjusted by the ENGINEER to reflect the effects of job conditions, technical difficulties, strikes, unavoidable delays on the part of the OWNER or his representatives, and other unforeseeable conditions which may indicate schedule adjustments and/or completion time extension. Under such conditions, the CONTRACTOR shall reschedule the work and/or Contract completion time to reflect the changed conditions, and the CONTRACTOR shall revise his schedule accordingly. No additional compensation shall be made to the CONTRACTOR for such schedule changes except for unavoidable overall Contract time extensions beyond the actual completion of all unaffected work in the Contract, in which case the CONTRACTOR shall take all possible action to minimize any time extension and any additional cost to the OWNER. It is specifically pointed out that the use of available float time in the schedule may be used by the OWNER as defined by the ENGINEER, as well as by the CONTRACTOR. Float time is defined as the amount of time between the early start date and the late start date or the early finish date and the late finish date of any of the activities in the schedule.

- f. The OWNER controls the float time in the current schedule and is, therefore, without obligation to extend either the overall completion date or any intermediate completion dates set out in the schedule, the OWNER may initiate changes to the Contract work that absorb float time only. CONTRACTOR-initiated changes that encroach on the float time identified in the current schedule may be accomplished with the OWNER'S concurrence. Such changes, however, shall give way to OWNER-initiated changes competing for the same float time.

1.05 CHANGE ORDERS

Upon approval of a change order, the approved change shall be reflected in the next scheduled submittal by CONTRACTOR.

1.06 CPM STANDARDS

- A. Definition. CPM, as required by this Section, shall be interpreted to be generally as outlined in the Associated General Contractors' publication, "The Use of CPM in Construction".
- B. Work Schedules. Work schedules shall include a graphic network and computerized, tabulated schedules as described below. The schedule must demonstrate the following:
 - 1. A logical succession of work from start to finish. This logical succession is the CONTRACTOR'S work plan and is only designated as early start to accommodate standard computerized systems.
 - 2. Definition of each activity.
 - 3. Show all work activities and interfaces including all submittals and major material and equipment deliveries.
- C. Duration. The duration indicated for each activity shall be in calendar days and shall represent the single best time considering the scope of the Work and resources planned for the activity including time for inclement weather.
- D. Tabulated Schedules. The initial schedule shall include the following minimum data for each activity.

1. Activity numbers
 2. Estimated duration
 3. Activity description
 4. Early start date (Calendar Dated)
 5. Early finish date (Calendar Dated)
 6. Status (Whether Critical)
 7. Float
- E. Project Information. Each tabulation shall be prefaced with the following summary data.
1. Project Name
 2. CONTRACTOR
 3. Type of Tabulation (Initial or Update)
 4. Project Duration
 5. Project Scheduled Completion Date
 6. Project Completion Date
 7. Variance Analysis per activity

1.07 SCHEDULE MONITORING

- A. At not less than monthly intervals or when specifically requested by the ENGINEER, the CONTRACTOR shall submit to the ENGINEER a computer printout of an updated schedule for those activities that remain to be completed.
- B. The revised schedule shall be submitted in the form, sequence, and number of copies requested for the initial schedule.

1.08 SHOP DRAWING SUBMITTAL SCHEDULE

- A. The CONTRACTOR will be required to submit a complete and detailed listing of anticipated shop drawing submittals during the course of the Contract. The CONTRACTOR will coordinate his submittals with those of his Subcontractors and Suppliers and will identify each submittal by Contract drawing number and specification number. Durations shown for review shall be shown to share available float for that path. Submissions, the review of which is on the critical path, shall be clearly marked in red with the words “Critical Path” by the CONTRACTOR at the time of submission.
- B. The Submittal Schedule must be submitted within twenty (20) working days of the Notice to Proceed and will be the subject of a meeting with the ENGINEER. At that meeting, the Submittal Schedule will be reviewed for comprehensiveness and feasibility. The Submittal Schedule will then be revised as required and the CONTRACTOR will incorporate the dates and review durations into his CPM Schedule.

1.09 STARTUP SCHEDULE SUBMITTALS

- A. At least ninety (90) calendar days prior to the date of Substantial Completion, the CONTRACTOR shall submit a startup schedule consisting of a time-scaled diagram and supporting narrative detailing the work to take place during the sixty (60) day period leading up to Substantial Completion. ENGINEER shall have twenty (20) calendar days after receipt of submittal to respond. Upon receipt of ENGINEER’S comments, the CONTRACTOR shall make the necessary revisions and submit the revised schedule within ten (10) calendar days. If the CONTRACTOR does not provide an acceptable schedule and narrative upon which progress during the sixty (60) day period can be assessed, the OWNER may withhold progress payments until such time as an acceptable schedule and narrative are submitted.
- B. This startup schedule shall be coordinated with the schedule, but shall not be combined with or incorporated into the schedule. The startup schedule shall provide a greater level of detail for showing all startup and testing activities.
- C. Startup schedule submittal requirements shall run concurrent with and in addition to the schedule requirements. The CONTRACTOR shall submit each month the revised startup diagram and narrative highlighting percentages of completion, actual start and finish dates, new activities as required, and remaining durations for all startup activities identified.
- D. ENGINEER’S review of startup schedules shall be concurrent with and subject to the same requirements and limitations of the schedule and narrative.

1.10 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES

- A. The CONTRACTOR is responsible for coordinating the schedules of the Subcontractors into an overall schedule and shall act as the construction coordinator. The CONTRACTOR'S preparation of the overall schedule each month in no way relieves the subcontractors from their responsibility to complete the project on time and to update their own schedules monthly. In case of interference between the operations of the CONTRACTOR and his/her Subcontractors, the CONTRACTOR shall be held fully responsible for determining the work priority of each Subcontractor and the sequence of work necessary to expedite the completion of the entire project. Any delays in the Work due to such circumstances shall not be considered as justification for claims for additional compensation.

END OF SECTION

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SECTION 01390

CONSTRUCTION PHOTOGRAPHS AND VIDEOTAPING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall employ a competent photographer to take construction record photographs and audio/video record all construction areas within the project area prior to, during the course of, and after the Work. CONTRACTOR shall be responsible for the production of construction videos and photographs as provided herein. No payment will be made to CONTRACTOR until acceptable preconstruction videos and photographs are received.
- B. CONTRACTOR shall produce a video recording in digital format acceptable to the OWNER and ENGINEER. The video recording shall detail the entire route of the pipeline. Two (2) copies of the video recording shall be submitted to ENGINEER for approval before commencement of Work. The video recording shall include all roads adjacent to the project route used by construction traffic. The video recording shall be produced by a competent video photographer and shall be color and commercial quality. The ENGINEER shall be present at the time the video recording is produced. The same views shall be re-videoed upon completion of construction activities. The video recording shall identify the physical conditions of the site. The video recording shall identify, at a minimum, all asphalt, concrete, gravel, or grassed surfaces; locations of curbs and gutters, sidewalks, wheelchair ramps, driveways, landscaped areas, retaining walls, fences, signs, and mail boxes; and locations of existing utility manholes, valve boxes, meter boxes, control panels, and power poles.
- C. Digital photographs shall be taken of all equipment, fittings, valves, and connections to the pipe prior to backfill. Up to four (4) photographs will be required at each fitting, valve, and system connection. The view of each of the photographs will be as established by the ENGINEER. Digital photographs shall also be taken at intervals of approximately 100 feet along the route of the pipeline before the commencement of Work and promptly submitted to ENGINEER. The same views shall be rephotographed upon completion of construction activities. All photographs shall be produced by a competent photographer and shall be color digital photographs of commercial quality. An electronic file and two 4- by 5-inch prints of each view shall be submitted. Electronic files shall be identified with description of view and date. Prints shall be mounted on linen with flap for binding or enclosed in clear, archival plastic binders and marked with the name and number of the Contract, name of the CONTRACTOR, description and location of view, and date photographed.
- D. Photographer shall agree to furnish additional prints to OWNER and the ENGINEER at commercial rates applicable at time of purchase. Photographer shall also agree to participate as required in any litigation requiring the photographer as an expert witness.

1.02 PRECONSTRUCTION AUDIO/VIDEO DVDS

- A. DVD recordings shall be made not more than sixty (60) days prior to construction, thirty (30) days after clearing and grubbing, and sixty (60) days after Substantial Completion. No construction shall begin prior to the ENGINEER'S review and approval of the DVDs covering the construction area. The ENGINEER shall have the authority to reject all or any portion of a DVD not conforming to Specifications and require that it be redone at no additional charge. The CONTRACTOR shall reschedule unacceptable coverage within five (5) days after being notified. The ENGINEER shall designate those areas, if any, to be omitted from or added to the audio/video coverage. All original DVDs and written records shall become the property of the OWNER.
- B. The CONTRACTOR shall engage the services of a professional videographer. The color audio/video DVDs shall be prepared by a responsible commercial firm known to be skilled and regularly engaged in the business of construction color audio/video DVD documentation. The videographer shall furnish to the ENGINEER a list of all equipment to be used for the audio/video recording, (i.e., manufacturer's name, model number, specifications, and other pertinent information). Additional information to be furnished by the videographer shall include the names and addresses of two references that the videographer has performed color audio/video recording for projects of a similar nature including one within the last twelve (12) months.

1.03 COST OF PHOTOGRAPHY AND VIDEO RECORDING

- A. The CONTRACTOR shall pay costs for specified photography, video recording, prints, and DVD. The cost of the photography and video recording shall be a subsidiary obligation of the CONTRACTOR, and no separate payment will be made.
 - 1. Parties requiring additional photography, video recording, prints, or DVDs will pay photographer directly.

1.04 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01720: Project Record Documents.

PART 2 - PRODUCTS

2.01 PRINTS

A. Color:

1. Paper: Single weight, color print paper
2. Finish: Matte
3. Size: 8- x 10-inch

B. Identify each print on back, listing:

1. Name of Project
2. Orientation of View
3. Date and time of exposure
4. Name and address of photographer
5. Photographer's numbered identification of exposure

2.02 DVD

- A. The video shall be on a professional-quality DVD.

2.03 AUDIO/VIDEO RECORDING

- A. The total audio/video system and the procedures employed in its use shall be such as to produce a finished product that will fulfill the technical requirements of the project. The video portion of the recording shall produce bright, sharp, clear pictures with accurate colors and shall be free from distortion or any other form of picture imperfection. All video recordings shall be electronic means, display on the screen the time of day, the month, day and year of the recording. This time and date information must be continuously and simultaneously generated with the actual recording. The audio portion of the recording shall produce the commentary of the camera operator with proper clarity and be free from distortion.

B. DVDs

DVDs shall be new and thus shall not have been used for any previous recording. Two complete sets of DVDs (one original and one copy) and logs shall be provided upon acceptance of recordings.

PART 3 - EXECUTION

3.01 TECHNIQUE

- A. Factual presentation
- B. Correct exposure and focus
 - 1. High resolution and sharpness
 - 2. Maximum depth-of-field
 - 3. Minimum distortion

3.02 VIEWS REQUIRED

- A. Photograph from location to adequately illustrate condition of construction and state of progress.
 - 1. Consult with the ENGINEER at each period of photography for instructions concerning views required.

3.03 ASSEMBLY OF PRINTS

- A. Each print shall be inserted in a separate, archival type, nonglare, three (3) hole punched photo protector.
- B. Provide suitably sized 3-ring binder for each set of prints (total of three). Binders shall be provided in sufficient quantity to hold all photographs taken for the duration of the contract. Each binder shall be labeled by engraving on the front and spine with the project name.

3.04 DELIVERY OF PRINTS

- A. Deliver prints to the ENGINEER to accompany each Application for Payment.
- B. Distribution of prints as soon as processed is anticipated to be as follows:
 - 1. ENGINEER (one set)
 - 2. OWNER (one set)
 - 3. Project Record File (one set)

- C. No construction shall start until preconstruction photography and videotaping is completed and submitted to ENGINEER.

3.05 AUDIOVISUAL RECORDING

- A. The recordings shall contain coverage of all surface features within the construction zone of influence. These features shall include, but not be limited to, all roadways, pavement, retention ponds, railroad tracks, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, landscaping, trees, visible utilities, fences, structures, and buildings. Of particular concern shall be the condition of existing vegetation, terrain, and structures and the existence or nonexistence of any faults, fractures, or defects. Panning, zoom-in and zoom-out rates shall be sufficiently controlled to maintain a clear view of the object.
- B. Accompanying the video recording of each DVD shall be a corresponding and simultaneously recorded audio recording. This audio recording, exclusively containing the commentary of the camera operator, shall assist in viewer orientation and in any needed identification, differentiation, clarification, or objective description of the features being shown in the video portion of the recording. The audio recording shall also be free from any conversation between the camera operator and any other production technicians.
- C. In general, the views will comprise a 360-degree panorama every 500 feet of piping length plus specifically designated close-up views for pre-and post-construction video photography.
- D. DVD Indexing
 - 1. DVD Identification: All DVDs and plastic boxes (archival type) shall be permanently labeled and shall be properly identified by DVD number, OWNER'S name, date of taping, location and standing limit of DVD and project name and number.
 - 2. DVD Log: Each DVD shall have a log of that DVD's contents. The log shall describe the various segments of coverage contained on that DVD in terms of the names of the streets or easements, coverage beginning and end, directions of coverage, video unit counter numbers, engineering stationing numbers when possible, and the date of the recording. Video logs shall be supplied in three ring vinyl cover binders and labeled on the front and spine with project name, date and location (i.e., service area).
- E. Visibility: All recording shall be performed during times of good visibility. No recording shall be done during periods of significant precipitation, mist, or fog. The recording shall only be performed when sufficient sunlight is present to properly illuminate the subject and to produce sharp, bright video recordings of those subjects.

F. The average rate of travel during a particular segment of coverage shall be directly proportional to the number, size, and value of the surface features within that construction area's zone of influence.

G. Camera Operation

1. Camera Height and Stability: When conventional wheeled vehicles are used as conveyances for the recording system, the vertical distance between the camera lens and the ground shall not exceed ten (10) feet. The camera shall be firmly mounted such that transport of the camera during the recording process will not cause an unsteady picture.
2. Camera Control: Camera pan, tilt, zoom-in and zoom-out rates shall be sufficiently controlled such that recorded objects shall be clearly viewed during video playback. In addition, all other camera and recording system controls, such as lens focus and aperture, video level, pedestal, chroma, white balance and electrical focus shall be properly controlled or adjusted to maximize picture quality.
3. Viewer Orientation Techniques: The audio and video portions of the recording shall maintain viewer orientation. To this end, overall establishing views of all visible house and business addresses shall be utilized. In areas where the proposed construction location will not be readily apparent to the video viewer, highly visible yellow flags shall be placed, by the CONTRACTOR, in such a fashion as to clearly indicate the proposed center line of construction.

END OF SECTION

SECTION 01410

TESTING AND TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. OWNER will select and pay for an independent testing laboratory to perform the following tests:
 - 1. Concrete placement tests, including slump, air content, and compressive strength (cores and cylinders) in accordance with Section 03100.
 - 2. Pavement compaction and density testing in accordance with Section 02500.
 - 3. Soil moisture, density, and compaction testing as specified in Section 02200.
 - 4. Ductile iron pipe and fittings testing as specified in Section 02610 for both water and sewer mains.
 - 5. Sanitary Sewer Manholes as specified in Section 02720.
- B. OWNER may at any other time elect to have other materials and equipment tested for conformity with the Contract Documents.
- C. CONTRACTOR shall select (subject to OWNER'S approval), coordinate, and pay for all other testing and test lab services not specified in 1.01 A. Costs for these tests shall be included in the CONTRACTOR'S Base Bid.
- D. CONTRACTOR shall cooperate with testing laboratories and personnel to facilitate the execution of the required testing services.
- E. Employment of testing laboratories shall in no way relieve CONTRACTOR'S obligations to perform the Work of the Contract.
- F. Costs for any tests that show noncompliance with the Contract Documents shall be at the CONTRACTOR'S expense.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities.

- B. Respective sections of Specifications: Certification of products.
- C. Each Specification section listed: Laboratory and field tests required, and standards for testing.

1.03 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the CONTRACTOR.

1.04 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with laboratory personnel and provide access to work and manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representative samples of materials proposed to be used and requiring testing.
- C. Submit to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which require control by the testing laboratory.
- D. Materials and equipment used in the performance of work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard specifications for quality and workmanship are indicated in the Contract Documents. The ENGINEER may require the CONTRACTOR to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.

- F. Notify ENGINEER sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of concrete, pavement, and soils compaction tests.
1. When tests or inspections cannot be performed after such notice, reimburse OWNER for laboratory personnel, travel, and other incidental expenses incurred.
- G. Employ and pay for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required for the CONTRACTOR'S convenience.
- H. If the test results indicate the material or equipment complies with the Contract Documents, the OWNER shall pay for the cost of the testing laboratory. If the tests and any subsequent retests indicate the materials and equipment fail to meet the requirements of the Contract Documents, the total of such costs shall be deducted from any payments due the CONTRACTOR.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01500
TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Furnish, install, and maintain temporary utilities required for construction, remove on completion of work. Temporary utilities defined herein include utilities in both construction and startup of the project.

1.02 RELATED REQUIREMENTS

- A. Section 01010: Summary of Work.
- B. Section 01590: Field Offices.

1.03 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with National Electrical Code.
- B. Comply with federal, state, and local codes and regulations and with utility company requirements.
- C. Comply with local health department regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials may be new or used but must be adequate in capacity for the required usage, must not create unsafe conditions, and must not violate requirements of applicable codes and standards.

2.02 TEMPORARY ELECTRICITY AND LIGHTING

- A. Provide adequate artificial lighting for all areas of work when natural light is not adequate for work and for areas accessible to the public.

2.03 TEMPORARY WATER

- A. Provide water to the project site during construction. CONTRACTOR may arrange with the OWNER to obtain water from a hydrant on or near the site or connect to the OWNER'S water system, if a water main has been installed and is in operation adjacent to the site. The connection point shall be approved in writing by the OWNER.
- B. If a connection is made to the OWNER's water system, the CONTRACTOR shall:
 - 1. Install branch piping with taps located so that water is available throughout the construction by the use of hoses. Protect piping and fittings against freezing as applicable to the work site.
 - 2. Install at each and every connection to the OWNER'S water supply a reduced-pressure double backflow preventer. CONTRACTOR shall be required to meter and reimburse OWNER for all water used.

2.05 TEMPORARY SANITARY FACILITIES

- A. Provide sanitary facilities in compliance with laws and regulations.
- B. Service, clean, and maintain facilities and enclosures.

2.06 ENCLOSURES AND CONSTRUCTION FACILITIES

- A. Furnish, install, and maintain for the duration of construction, all required scaffolds, tarpaulins, canopies, steps, bridges, platforms and other temporary construction necessary for proper completion of the Work in compliance with all pertinent safety and other regulations.
- B. Provide appropriate enclosures for storage of materials and equipment prior to installation.

PART 3 - EXECUTION

3.01 GENERAL

- A. Maintain and operate systems to assure continuous service.
- B. Modify and extend system as work progress requires.

3.02 REMOVAL

- A. Completely remove temporary materials and equipment when their use is no longer required.
- B. Clean and repair damage caused by temporary installations or use of temporary facilities.
- C. Restore permanent facilities used for temporary services to specified condition.

END OF SECTION

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SECTION 01510

MAINTENANCE OF FLOW IN EXISTING SEWERS AND DRAINS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required to maintain wastewater and storm drainage flow in all public and private pipes, including individual service connections, during construction.
- B. Maintain required by-pass pumping equipment on-site during connection to existing sewer to prevent backing up of sewage and to allow proper inspection, rehabilitation, testing, or drainage during pipe replacement and/or rehabilitation. There shall be no spillage during the by-pass pumping. If spillage occurs, the CONTRACTOR shall immediately remove and dispose of all offensive matter spilled during the by-pass pumping at his own expense.

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit to the ENGINEER a schedule to complete the work. It will include the sequencing and coordination of pipeline cleaning, inspection, rehabilitation, testing, and the handling of wastewater flow during construction.
- B. The CONTRACTOR shall submit to the ENGINEER, for approval, a detailed written plan of all methods of flow maintenance ten (10) days in advance of flow interruption. All procedures for maintaining flows must meet the approval of the OWNER and ENGINEER.
- C. The CONTRACTOR shall prepare a specific, detailed description of the proposed pumping system for storm work (Bypass Pumping Plan). The Bypass Pumping Plan shall be submitted and approved prior to the mobilization of any of the equipment included in the Bypass Pumping Plan. The Bypass Pumping Plan shall outline all provisions and precautions to be taken by the CONTRACTOR regarding handling of existing wastewater flows. This Bypass Pumping Plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified herein. No construction shall begin until all provisions and requirements have been reviewed and accepted by the ENGINEER. The plan shall include but not be limited to the following details:

1. Staging areas for pumps.
2. Sewer plugging method and types of plugs.
3. Size and location of manholes or access points for suction and discharge hose or piping.
4. Size of pipeline or conveyance system to be bypassed.
5. Number, size, material, location and method of installation of suction piping.
6. Number, size, material, location and method of installation of discharge piping.
7. Bypass pump sizes, capacities, and number of each size to be provided on site including primary all primary and secondary pumping units.
8. Any temporary pipe supports and anchoring requirements.
9. Access plans to all bypass pumping locations indicated on the drawings.
10. Emergency plan for adverse weather and flooding for the cleaning phase and the cured-in-place lining phase of the work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 MAINTENANCE OF FLOW IN EXISTING SEWERS AND DRAINS

- A. When by-pass pumping is required the CONTRACTOR shall supply pumps, conduits, power, and other equipment to divert the flow of sewage or drainage around the section in which work is to be performed. The by-pass system shall be of sufficient capacity to handle existing flows plus additional flows that may occur during a rain event.
- B. Flows from private, commercial and industrial users shall be handled by the CONTRACTOR during rehabilitation of the sewer system without interruption.
- C. The CONTRACTOR shall be required to repair at his own expense any damage to public or private property caused by his operations.
- D. Should damage of any kind occur to the existing drains or sewers, the CONTRACTOR shall at his own expense make repairs to the satisfaction of the ENGINEER.

- E. The CONTRACTOR shall not be permitted to overflow, bypass, pump or by any other means convey drainage to any land, street, storm drain or water course.
- F. Any and all flow maintenance activities shall in no way impede traffic flow. Traffic flow must be maintained at all times.
- G. The CONTRACTOR shall immediately notify the OWNER should a sanitary sewer overflow occur and take the necessary action to recover, remove and mitigate in an approved manner the spillage to the satisfaction of the OWNER and/or other governmental agency. If sewage is spilled onto public or private property, the CONTRACTOR shall washdown, cleanup, and disinfect the spillage to the satisfaction of the OWNER and/or other governmental agency.

END OF SECTION

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SECTION 01570

TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The CONTRACTOR shall furnish, install, operate and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow during construction.
- B. All traffic control on City roads shall be in strict accordance with the requirements of the City of Griffin Transportation Division. All traffic control on City roads shall in strict accordance with the requirements of the Georgia Department of Transportation (GDOT).

1.02 SUBMITTALS

- A. The CONTRACTOR shall submit to the ENGINEER a detailed traffic control plan for all work in City of Griffin roads. The traffic control plan shall be prepared in accordance with the *Georgia Department of Highways Manual on Uniform Traffic Control Devices* (GAMUTCD) and shall be specific to each road. The plan shall include details of the location and quantity of barricades, codes, flashing lights, flagmen, etc. The plan shall identify all lane closures and shall state durations for the lane closures. The ENGINEER and the City shall review the traffic control plan. The ENGINEER shall provide written comments to the CONTRACTOR. The traffic control plan shall be modified as necessary in the field to accommodate unforeseen traffic control issues and problems and safety concerns. The CONTRACTOR shall be required to resubmit detailed plans showing the modifications as requested by the ENGINEER. Lane closure shall be limited to the extent practicable. Access for emergency vehicles and access to businesses and residences along the roads shall be maintained at all times.

1.03 RELATED REQUIREMENTS

- A. Section 01015: Construction Sequence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 TRAFFIC CONTROL

- A. The CONTRACTOR shall fully implement the approved traffic control plans. The traffic control devices shall be in place prior to performing any work within the roads. The CONTRACTOR shall maintain all traffic control equipment and monitor the traffic control measures. The traffic control measures shall be modified as deemed necessary by the CONTRACTOR, the ENGINEER, or City. The CONTRACTOR shall fully cooperate with the ENGINEER and City officials during inspections of the traffic control measures. The CONTRACTOR shall remove temporary equipment and facilities when no longer required and restore grounds to the original or specified conditions.
- B. The CONTRACTOR shall notify all property owners at least 72 hours in advance of any work which will interfere with access to their residence or place of business.
- C. No road shall be closed to traffic without the prior consent of the ENGINEER, the agency responsible for the road, and the local police department. All standards of the governing agency shall be strictly followed.
- D. Use of plates will be permitted; however, the plates shall be properly anchored to the existing pavement to prevent movement of the plates. Plates shall be recessed to create a level and smooth travel surface for vehicles.
- E. The CONTRACTOR is advised that the entire roadway must be open and available for the movement of traffic during all non-working hours. During all non-working hours, the roadway must be restored to a condition suitable for the movement of traffic.

3.02 CONSTRUCTION PARKING CONTROL

- A. The CONTRACTOR shall control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, or construction operations.
- B. The CONTRACTOR shall monitor parking of construction personnel's private vehicles, maintain free vehicular access to and through parking areas and prohibit parking on or adjacent to access roads or in State or City DOT roadways.
- C. No parking shall be allowed on any private roads or driveways.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDED

A. This Section specifies the general requirements for the delivery, handling, storage, and protection of all items required in the construction of the work. Specific requirements:

1. Conform to applicable specifications and standards.
2. Comply with size, make, type, and quality specified or as specifically approved in writing by the ENGINEER.
3. Manufactured and Fabricated Products
 - a. Design, fabricate, and assemble in accord with the best engineering and shop practices.
 - b. Manufacture like parts of duplicate units to standard sizes and gauges to be interchangeable.
 - c. Two (2) or more items of the same kind shall be identical—by the same manufacturer.
 - d. Products shall be suitable for service conditions.
 - e. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to, unless variations are specifically approved in writing.
4. Do not use products for any purpose other than that for which they are designed or specified.

1.02 RELATED REQUIREMENTS

- A. Conditions of the Contract.
- B. Section 01010: Summary of Work.
- C. Section 01300: Submittals.
- D. Section 01630: Substitutions and Product Options.

1.03 APPROVAL OF PRODUCTS

- A. Only new products shall be incorporated in the Work.
- B. All products shall be subject to the inspection and approval of the ENGINEER. No products shall be delivered to the Work without prior approved Shop Drawings.
- C. Furnish all required facilities and labor for handling and inspection of Products. If requested, either prior to beginning or during the progress of the work, submit samples of materials for such special tests as may be necessary to demonstrate that they conform to the Specifications. Such samples shall be furnished, stored, packed, and shipped as directed at the CONTRACTOR'S expense.
- D. Submit Shop Drawings, Product Data, and Samples sufficiently in advance to permit consideration and approval before Products are necessary for incorporation in the work. Any delay of approval resulting from the failure to submit Shop Drawings, Product Data, or Samples in a timely manner shall not be used as a basis of claim against the OWNER or the ENGINEER.
- E. In order to demonstrate the proficiency of workmen or to facilitate the choice among several textures, types, finishes and surfaces, provide such samples of workmanship or finish as may be required or requested.
- F. Products used in the Work shall correspond to the approved Shop Drawings, Product Data, Samples or other data.

1.04 TRANSPORTATION AND HANDLING

- A. Arrange deliveries of Products in accordance with construction schedules, coordinate to avoid conflict with work and conditions at the site.
 - 1. Deliver Products to the site in undamaged condition, in manufacturer's original sealed containers or packaging, with identifying labels intact and legible, complete with instructions for handling, storing, unpacking, protecting, and installing.
 - 2. Schedule delivery to reduce long-term, on-site storage prior to installation and/or operation.
 - 3. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.
 - 4. Products delivered to the site shall be unloaded and placed in a manner which will not hamper the CONTRACTOR'S normal construction operations, or those of other contractors and subcontractors. Unloading shall not interfere with normal traffic flow.

5. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and that Products are properly protected and undamaged.

B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage to Products or packaging.

1.05 STORAGE AND PROTECTION

A. Furnish a covered, weather-protected storage structure providing a clean, dry, ventilated, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment, and special equipment to be incorporated into the Work. Storage of equipment shall be in strict accordance with the “instructions for storage” of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc. Five (5) copies of the manufacturer’s instructions for storage shall be delivered to the ENGINEER prior to storage of all equipment and materials. Corroded, damaged or deteriorated equipment and parts shall be replaced before acceptance of the Work. Products not properly stored shall not be included in Applications for Payment.

B. Store Products in accordance with manufacturer’s instructions, with seals and labels intact and legible.

1. Store Products subject to damage by the elements in weather-tight enclosures. Maintain temperature and humidity within the ranges required by manufacturer’s instructions.

2. Store fabricated Products above the ground, on blocking or skids, to prevent soiling or staining. Cover products which are subject to deterioration with impervious sheet coverings.

3. Provide adequate ventilation to prevent condensation.

4. Store loose granular materials in a well-drained area on solid, flat surfaces to prevent mixing with foreign matter.

C. All Products shall be handled and stored before, during, and after shipment in a manner to prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind whatsoever to the material or equipment.

D. All Products which, in the opinion of the ENGINEER, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the Work. No compensation will be made for the damaged Products, their removal, or their replacement.

- E. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored Products to assure that Products are maintained under specified conditions and free from damage or deterioration.
- F. Protection after Installation – Provide substantial coverings as necessary to protect installed Products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.
- G. Maintain full responsibility for all material, equipment, and supplies until final inspection of the work and acceptance thereof by the OWNER and ENGINEER. In the event any such material, equipment and supplies are lost, stolen, damaged, or destroyed prior to final inspection and acceptance, the CONTRACTOR shall replace same without additional cost to the OWNER.
- H. Should proper action regarding storage and handling of equipment supplied under this Contract not be taken within seven (7) days after written notice to do so has been given, the OWNER retains the right to correct all deficiencies noted in previously transmitted written notice and deduct the cost associated with these corrections from the Contract Price. These costs may be comprised of expenditures for labor, equipment usage, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.

1.06 STORAGE AND HANDLING OF EQUIPMENT ON-SITE

- A. Because of the long period allowed for construction, special attention shall be given to the storage and handling of equipment on-site. As a minimum, the procedure outlined below shall be followed.
 - 1. Equipment shall not be shipped until approved by the ENGINEER. The intent of this requirement is to reduce on-site storage time prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one (1) month prior to installation without written authorization from the ENGINEER. Operation and maintenance data shall be submitted to the ENGINEER for review prior to shipment of equipment.
 - 2. All equipment having moving parts such as gears, electric motors, etc., and/or instruments shall be stored in a temperature- and humidity-controlled building approved by the ENGINEER, until such time as the equipment is to be installed.
 - 3. All equipment shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer.
 - 4. A copy of the manufacturer's storage instructions shall be given to the ENGINEER and shall be carefully studied by the CONTRACTOR and reviewed with the

ENGINEER by him. These instructions shall be carefully followed and a written record of this kept by the CONTRACTOR.

5. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal “welding”. Upon installation of the equipment, the CONTRACTOR shall start the equipment, at at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
6. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. Mechanical equipment to be used in the work, if stored for longer than ninety (90) days, shall have the bearings cleaned, flushed, and lubricated prior to testing and startup.
7. Prior to acceptance of the equipment, the CONTRACTOR shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective, and it shall be removed and replaced at no expense to OWNER.

1.07 MANUFACTURER’S INSTRUCTIONS FOR INSTALLATION

- A. When the Contract Documents require that installation of Products shall comply with manufacturer’s printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including five (5) copies to the ENGINEER. Maintain one (1) set of complete instructions at the job site.
- B. Handle, install, connect, clean, condition and adjust Products in strict accord with such instructions and in conformity with specified requirements.
 1. Should job conditions or specified requirements conflict with manufacturer’s instructions, consult with ENGINEER for further instructions.
 2. Do not proceed with work without clear instructions.
- C. Perform work in accordance with manufacturer’s instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

DIVISION 2

SITEWORK

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SECTION 02080

ABANDONMENT, REMOVAL AND DISPOSAL OF EXISTING PIPE REMOVED FROM SERVICE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: Furnish all labor, materials, equipment and incidentals required to abandon, remove, salvage and/or dispose of existing pipelines as shown on the Drawings and as specified herein.

1.02 QUALITY ASSURANCE

- A. Permits and Licenses: Contractor shall obtain and pay respective fees for all necessary permits and licenses for performing the Work and shall furnish a copy of same to the Engineer prior to commencing the Work. The Contractor shall comply with the requirements of the permits.
- B. Notices: Contractor shall issue written notices of planned work to companies or local authorities owning utility conduit, wires or pipes running to or through the project site. Copies of said notices shall be submitted to the Engineer.
- C. Standards:
 - 1. National Emission Standards Hazardous Air Pollution (NESHAP), 40 CFR Part 61, Subpart M, latest revision.
 - 2. Occupational Safety and Health Act, 29 CFR
- D. Quality Control
 - 1. It shall be the responsibility of the Contractor to provide supervision and inspections to ensure that the existing piping is removed and disposed, salvaged or abandoned as designated in the Drawings and as specified herein.

PART 2 - MATERIALS (Not Used)

PART 3 - EXECUTION

3.01 REMOVAL AND DISPOSAL

- A. General: Existing piping designated on the Drawings to be removed shall be exposed and removed by the Contractor in accordance with the requirements specified herein.
- B. Types of pipe to be removed:
 - 1. Corrugated Metal Pipe (CMP)
 - 2. Concrete junction boxes, inlet boxes, and drop inlets
- C. Removal and Disposal:
 - 1. Pipe designated to be removed and disposed by the Contractor shall be completely drained and the contents properly disposed. The pipe shall then be completely removed from the site, including fittings, valves and all other in-line devices.

END OF SECTION

SECTION 02110

SITE PREPARATION

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Clear work area of plant life and grass.
- B. Remove surface debris.
- C. Disposal of material.

1.02 RELATED WORK

- A. Section 02200 - Earthwork.

1.03 GENERAL

The CONTRACTOR shall furnish all labor, materials, tools, and equipment necessary to prepare the site as indicated on the Drawings and as herein specified.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CLEARING

- A. Clear areas required for access to site and execution of work.
- B. Remove trees, shrubs, brush, and other vegetable matter such as snags, bark, and refuse.

3.02 PROTECTION

- A. The CONTRACTOR shall not cut or injure any trees or other vegetation outside the easement lines and outside the areas to be cleared, as indicated on the Drawings, without written permission from the ENGINEER. The CONTRACTOR shall be responsible for all damage done outside these lines. The ENGINEER shall designate which trees are to be removed within permanent and temporary easement lines.

- B. Restrict construction activities to those areas within the limits of construction designated on the Drawings, within public right-of-way, and within easements provided by the OWNER. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations shall be properly restored to their original condition, to the full satisfaction of the property owner at no additional cost to the OWNER.

3.03 GRUBBING

- A. From areas to be grubbed, the CONTRACTOR shall remove completely all stumps, remove to a depth of at least 18 inches below subgrade elevation all roots larger than 1 ½ inch in diameter, and remove to a depth of 6 inches all roots larger than ½ inch in diameter. Such depths shall be measured from the existing ground surface, the proposed finished grade or subgrade, whichever is lower.
- B. Refill all grubbing holes and depressions excavated below the original ground surface with common fill materials and compact to a density conforming to the surrounding ground surface in accordance with Section 02200.

3.04 STRIPPING

- A. All stumps, roots, foreign matter, topsoil, loam, and unsuitable earth shall be stripped from the ground surface. The topsoil and loam shall be utilized insofar as possible, for finished surfacing. Loam shall not be taken from the site.

3.05 DISPOSAL

- A. All material resulting from clearing and grubbing and not scheduled for reuse or stockpiling shall become the property of the CONTRACTOR and shall be suitably disposed of off site, unless otherwise directed by the ENGINEER, in accordance with all applicable laws, ordinances, rules and regulations.
- B. Such disposal shall be performed as promptly as possible after removal of the material and shall not be left until the final period of cleaning up. No rubbish or debris of any kind shall be burned on the site.

3.06 FENCES

Wherever fences need to be removed to provide access to the work or are damaged during the progress of work, they shall be restored or repaired to as good a condition as existed prior to construction at the CONTRACTOR'S expense. Temporary fencing shall be provided to protect the public.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish all labor and equipment required to dewater all excavations. Dewatering of all excavations shall be the responsibility of the CONTRACTOR, and no additional compensation will be allowed for same.

1.02 RELATED WORK

- A. Earthwork is included in Section 02200.
- B. Slope protection and erosion control is included in Section 02270.

1.03 SUBMITTALS

None.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

Dewatering of many of the construction excavations shall be required as necessary to provide a dry work environment as indicated by the drawings and these specifications. Dewatering equipment shall be of adequate size and quantity to assure maintaining proper conditions for installing pipe, concrete, backfill or other material or structure in the excavation. Dewatering shall include proper removal of any and all liquid, regardless of its source, from the excavation and the use of all practical means available to prevent surface runoff from entering any excavation.

Extra pumps shall be maintained on-site for use in the event of a breakdown of operating pumps.

The discharge of sediment laden water into any stream or body of water is prohibited.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.00 STATUTORY REQUIREMENTS

- A. All excavation, trenching, sheeting, bracing, etc., shall comply with the requirements of OSHA Excavation Safety Standards (29 CFR Part 1926.650 Subpart P) and state and local requirements. Where conflict between OSHA, state, and local regulations exists, the most stringent requirements shall apply.

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals necessary to perform all excavation work and grading; procure, place, and compact backfill and fill; and dispose of unsuitable, waste, and surplus materials as shown on the Drawings and as specified herein.
- B. Furnish and install temporary excavation support systems, including sheeting, shoring, and bracing, to ensure the safety of personnel and protect adjacent structures, piping, etc., in accordance with federal, state and local laws, regulations, and requirements. Trench boxes shall not be permitted for excavations exceeding 20 feet in depth.
- C. Remove from the excavation all materials which the ENGINEER may deem unsuitable for backfilling. The bottom of the excavation shall be firm, dry, and in all respects acceptable. If conditions warrant, deposit gravel for pipe bedding or gravel refill for excavation below grade, directly on the bottom of the trench immediately after excavation has reached the proper depth and before the bottom of the trench has become softened or disturbed by any cause whatever. The length of open trench shall be related closely to the rate of pipe laying. All excavation shall be made in open trenches.
- D. The CONTRACTOR shall examine the site, review the available subsurface information and undertake his own subsurface investigations prior to submitting his bid, taking into consideration all conditions that may affect his work. The OWNER and ENGINEER make no representation as to subsurface characteristics of locations other than the borings noted on the Drawings.
- E. Prior to the start of work submit the proposed method of backfilling and compaction to the ENGINEER for review.

1.02 RELATED WORK

- A. Section 02110: Site Clearing.
- B. Section 02140: Dewatering.
- C. Section 02270: Sedimentation and Erosion Control.
- D. Section 02500: Roadways, Markings, Guard Rails, and Appurtenances.
- E. Section 02900: Seeding and Sodding.

1.03 SUBMITTALS

No submittals required

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D698 – Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregates Mixtures Using 5.5-lb (2.49-kg) Rammer and 12-inch (305-mm) Drop (also known as Standard Proctor Analysis or AASHTO T-99).
 - 2. ASTM D1557 – Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregates Mixtures Using 10-lb (4.54-kg) Rammer and 18-inch (457-mm) Drop (also known as Modified Proctor Analysis or AASHTO T-180).
- B. Where reference is made to one of the above standards, the revision in effect at the time of Bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. At all structures, prior to the placement of bedding material, concrete work mats, structural fill, or structural concrete, coordinate with the soils testing laboratory to verify the suitability of the existing subgrade soil and to perform in-place soil density tests as required to verify that the bearing capacity of the subgrade is sufficient.
- B. Prior to and during the placement of backfill and fill, coordinate with the soils testing laboratory to perform in-place soil density tests to verify that the backfill/fill material has been compacted in accordance with the compaction requirements specified elsewhere. The ENGINEER may designate areas to be tested.

1.06 DEFINITIONS

- A. Where the phrase “in-the-dry” is used in these Specifications, it shall be defined to mean an excavation sub-grade that is stable with no ponded water, mud, or muck and shall be able to support construction equipment without rutting or disturbance and shall be suitable for the placement and compaction of fill material, pipe or concrete foundations.
- B. Where used in this Specification “structures” refers to all buildings, wetwells, manholes, and below-grade vaults. Stormwater structures and duct banks are not considered structures in this context.
- C. Wherever a compaction percentage is referred to herein, it shall mean “at least that percentage of maximum density or determined by laboratory compaction tests indicated”.

PART 2 - PRODUCTS

2.01 GENERAL

A. Structural Fill

- 1. Structural Fill shall be a mineral soil free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3-in	100
No. 4	20 - 90
No. 40	5 - 75
No. 200	0 - 40

Structural fill shall have maximum liquid limit of 40 percent (40%), a maximum plasticity index of 10 percent (10%) and a maximum dry unit weight at least 95 pcf as determined by ASTM D698.

- B. Common Fill shall consist of granular soil that is free from organic materials, topsoil, highly micaceous silt, debris or other deleterious materials which will deteriorate in time or which cannot be properly compacted. Common fill shall not contain stones larger than four inches in diameter and shall have a maximum of 75 percent (75%) passing the No. 200 sieve, a maximum liquid limit of 50, and a maximum plasticity index of 30. Common fill shall not contain granite blocks, broken concrete, masonry rubble or other similar materials. It shall have physical properties such that it can be readily spread and compacted during filling. Snow, ice and frozen soil will not be permitted.
- C. Select common fill shall be as specified above for common fill except that the material shall contain no stones larger than 2 inches in largest dimension.

D. Crushed Stone

1. Crushed stone shall conform to ASTM designation C-33 size or number designation as shown on the Drawings.
2. Crushed stone for roadway surfacing shall be crusher run as locally available in the Spaulding County area conforming to GDOT.

E. Screened Gravel

1. Screened gravel shall be used for pipe bedding as detailed and at other locations indicated on the Drawings.
2. Screened gravel shall consist of hard, durable, rounded or sub-angular particles of proper size and gradation and shall be free from sand, loam, clay, excess fines, and deleterious materials. The gravel shall be graded within the following limits:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
5/8-in	100
1/2-in	40 - 100
3/8-in	15 - 45
No. 10	0 - 5

F. Sand

1. Sand shall conform to ASTM C33 for fine aggregate.

G. Base course beneath asphalt concrete surfacing and concrete walkways shall be crusher run, ABC, or approved equal, as locally available in the Spaulding County area and conforming to GDOT requirements.

H. Timber used for excavation support systems shall be pressure treated with wood preservative for ground contact.

PART 3 - EXECUTION

3.01 PREPARATION

A. Test Pits

1. Perform exploratory excavation work (test pits) for the purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.

2. Test pits shall be backfilled as soon as the desired information has been obtained. Backfilled surfaces shall be stabilized in accordance with approved erosion and sedimentation control plans.

3.02 EXCAVATION SUPPORT

- A. Furnish, put in place and maintain sheeting and bracing required by federal, state, or local safety requirements to support the sides of the excavation and prevent loss of ground which could endanger personnel, damage or delay the work, or endanger adjacent structures. If the ENGINEER is of the opinion that at any point sufficient or proper supports have not been provided, he/she may order additional supports placed at the expense of the CONTRACTOR. Compliance with such order shall not relieve the CONTRACTOR from his/her responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
- B. Where sheeting and bracing is required to support the sides of trenches, engage a professional engineer, registered in the State of Georgia to design the sheeting and bracing. The sheeting and bracing installed shall be in conformity with the design, and certification of this shall be provided by the professional engineer.
- C. When moveable trench bracing such as trench boxes, moveable sheeting, shoring, or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe or disturbance of the pipe bedding and the screened gravel backfill.
 1. When installing rigid pipe (PCCP, RCP, DIP, etc.) any portion of the box extending below mid-diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This is to prevent the separation of installed pipe joints due to movement of the box.
 2. When installing flexible pipe (PVC, ABS solid wall, ABS truss, HDPE, etc.), trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below mid-diameter of the pipe. As trench boxes, moveable sheeting, shoring or plates are moved, screened gravel shall be placed to fill any voids created and the screened gravel and backfill shall be re-compacted to provide uniform side support for the pipe.
- D. Permission will be given to use steel sheeting in lieu of wood sheeting for the entire job wherever the use of sheeting is necessary. The cost for use of sheeting will be included in the bid items for pipe and shall include full compensation for driving, bracing, and later removal of sheeting.

- E. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction of other structures, utilities, or property, whether public or private. All voids left after withdrawal of sheeting shall be immediately refilled with sand by ramming with tools especially adapted to that purpose, by watering or otherwise as directed.
- F. No payment will be given for sheeting, bracing, etc., during the progress of the work. No payment will be given for sheeting which has actually been left in the trench for the convenience of the CONTRACTOR.
- G. Sheeting driven below mid-diameter of any pipe shall remain in place from the driven elevation to at least 1 foot above the top of the pipe.

3.03 EXCAVATION BELOW GRADE AND REFILL

- A. Whatever the nature of unstable material encountered or the groundwater conditions, trench drainage shall be complete and effective.
- B. If the CONTRACTOR excavates below grade through error or for the CONTRACTOR'S own convenience, or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, he may be directed by the ENGINEER to excavate below grade as set forth in the following paragraph, in which case the work of excavating below grade and furnishing and placing the refill shall be performed at his own expense.
- C. If the material at the level of trench bottom consists of fine sand, sand and silt, or soft earth which may work into the screened gravel notwithstanding effective drainage, the subgrade material shall be removed to the extent directed and the excavation refilled with a 6-inch layer of coarse sand or a mixture graded from coarse sand to the fine pea stone, as approved by the ENGINEER, to form a filter layer preserving the voids in the gravel bed of the pipe. The composition and gradation of gravel shall be approved by the ENGINEER prior to placement. Screened gravel shall then be placed in 6-inch layers thoroughly compacted up to the normal grade of the pipe. If directed by the ENGINEER, bank-run gravel shall be used for refill of excavation below grade.

3.04 GENERAL FILLING AND BACKFILLING PROCEDURES

- A. Fill and backfill materials shall be placed in lifts to suit the specified compaction requirements to the lines and grades required, making allowances for settlement and placement of cover materials (i.e., topsoil, sod, etc.). Soft spots or uncompacted areas shall be corrected.
- B. Fill and backfill materials shall not be placed on frozen surfaces or surfaces covered by snow or ice. Fill and backfill material shall be free of snow, ice, and frozen earth.

- C. Compaction in open areas may be accomplished by any of the following methods: compaction equipment, fully loaded 10-wheel trucks, tractor dozers weighing at least 30,000 pounds and operated at full speed, or heavy vibratory rollers. Compaction in confined areas (including areas within a 45-degree angle extending upward and outward from the base of a wall) and in areas where the use of large equipment is impractical, shall be accomplished by hand-operated vibratory equipment or mechanical tampers. Lift thickness shall not exceed 6 inches (measured before compaction) when hand-operated equipment is used.
- D. Fill and backfill shall not be placed and compacted when the materials are too wet to properly compact (i.e., the in-place moisture content of the soil at that time is no more than 3-percentage points above the optimum moisture content of that soil as determined by the laboratory test of the moisture-density relation appropriate to the specified level of compaction).
- E. To prevent longitudinal movement of the pipe, dumping backfill material into the trench and then spreading will not be permitted until selected material or screened gravel has been placed and compacted to a level 1 foot over the pipe.
- F. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

3.05 FILL AND BACKFILL PROCEDURES

- A. Fill and backfill material placed immediately adjacent to and within 10 feet of all structures shall be select common fill. Place and compact select common fill in even lifts of 6 inches (compacted thickness) uniformly around the structure.
- B. Common fill may be used in areas beyond those designated for select common fill unless shown or specified otherwise. Common fill shall be placed in even lifts having a maximum thickness (measured before compaction) of 6 inches.

3.06 EMBANKMENT FILL PROCEDURES

- A. Prior to placing embankment fill materials, all organic materials (including peat and loam) and loose inorganic silt material (loess) shall be removed from areas beneath the embankments. If the subgrade slopes are excessive, the subgrade shall be stepped to produce a stable, horizontal surface for the placement of embankment materials. The existing subgrade shall then be scarified to a depth of at least 6 inches.
- B. Embankment fill shall consist of common fill material and shall be placed and compacted in even lifts of 12 inches (compacted thickness).
- C. Rock may be used in embankment fill only with prior written approval of the ENGINEER.

3.07 IMPERVIOUS FILL

- A. Impervious fill shall be placed in controlled, even lifts having a maximum thickness (measured before compaction) of 6 inches. Compaction shall be sufficient to attain a permeability of less than 1×10^{-7} cm/sec.
- B. Moisture content of impervious fill to be compacted shall be maintained at or near its optimum moisture content (minus 2 to plus 3 percent).

3.08 COMPACTION REQUIREMENTS

- A. In all cases, unless otherwise noted herein, the top 36 inches of fill shall be compacted to a minimum of 90 percent (90%) modified proctor (ASTM D698) at or near its optimum moisture content.
- B. Sidewalks – Compact the top 2 feet of existing subgrade (and each 6-inch layer of fill, if applicable) to a minimum of 95 percent (95%) modified proctor (ASTM D698) at or near its optimum moisture content and 95 percent (95%) modified proctor (ASTM D698) at or near its optimum moisture content for areas below two feet below trench top.
- C. Roads, Paved Areas and Roadway Embankments – Compact the top 3 feet of existing subgrade and each layer of fill or backfill to a minimum of 98 percent (98%) modified proctor at or near its optimum moisture content (minus 2 to plus 3 percent).

3.09 TRENCH EXCAVATION AND BACKFILLING

- A. Excavation for all trenches required for the installation of pipes shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe or installing the pipe within the trenches, for bracing and supporting and for pumping and drainage facilities. CONTRACTOR shall render the bottom of the excavations firm and dry and in all respects acceptable to the ENGINEER. Asphaltic or concrete pavement and driveways, when encountered, shall be saw cut along smooth and straight lines before excavating.
- B. Rock shall be removed to a minimum 6-inch clearance around the bottom and sides of all pipes being laid.
- C. Where pipe is to be laid in gravel bedding or encased in concrete, the trench may be excavated by machinery to or just below the designated subgrade, provided that the material remaining in the bottom of the trench is no more than slightly disturbed.
- D. The CONTRACTOR shall meet the following criteria when his/her installation method includes the use of a steel box:

1. When installing rigid pipe (PCCP, RCP, DIP, etc.), any portion of the box extending below mid-diameter shall be raised above this point prior to moving the box ahead to install the next pipe. This procedure is to prevent the separation of installed pipe joints due to movement of the box.
 2. When installing flexible pipe (PVC, ABS solid wall, ABS truss, HDPE, etc.), the bottom of the box shall not extend below mid-diameter. This requirement is to prevent loss of soil between the box and the pipe bedding which could result in excessive deflection of the installed pipe.
- E. Where pipe is to be installed in fill of any type, fill shall be placed and compacted to the total depth required (rough-grade elevation) or 4 feet above top of pipe, minimum, and then re-excavated for pipe installation.
- F As soon as practicable after the pipe has been laid and jointed, backfilling shall begin. If required or shown, screened gravel shall be placed around the pipe to mid-diameter as shown on the Drawings. As the screened gravel is placed, it shall be compacted by suitable tools.
- G. Pipe elevations and alignment shall be checked and adjusted to within the project tolerances. The CONTRACTOR shall notify the ENGINEER when these tolerances are exceeded and shall propose how to correct the work.
- H. After the screened gravel bedding (if required) has been placed to the mid-diameter of the pipe, selected common fill as shown shall be placed to a depth of 1 foot over the top of the pipe. Material shall be thoroughly compacted by hand tamping as placed, with at least one man tamping for each man shoveling material into the trench.
- I. Where the pipes are laid in unpaved areas, the remainder of the trench shall be filled with common fill in layers not to exceed 1 foot and thoroughly compacted by rolling, ramming, or puddling sufficiently to prevent subsequent settling. The backfill shall be mounded 6 inches above the existing grade or as directed. Wherever a loam or gravel surface exists prior to excavation, it shall be removed, conserved, and replaced to the full original depth as part of the work under the pipe Bid Items. In some areas it may be necessary to remove excess material during the cleanup process, so that the ground may be restored to its original level and condition. If the CONTRACTOR prefers not to store loam, gravel, or topsoil he/she shall replace it with material of equal quality and in equal quantity.
- J. The top 4 inches of backfill shall be topsoil. After final grading, the topsoil shall be prepared and seeded as specified in Section 02900.

- K. Where the pipes are laid in streets or other paved areas, the remainder of the trench above the bedding and up to a depth of 10 inches below the bottom of the specified paving shall be backfilled with common fill in 6-inch (maximum) layers and thoroughly compacted by rolling or ramming as the ENGINEER may direct.
- L. The 8-inch layer above the common fill of the specified paving shall be crusher run or ABC.
- M. The top 4 inches of backfill of the specified paving shall be temporary pavement until replaced with permanent pavement as specified in Section 02500.
- N. Compacted backfill shall have an in-place density of at least 95 percent (95%) of maximum dry density as measured by a standard proctor test described in ASTM D698. Compacted backfill within paved areas shall have an in-place density of at least 98 percent (98%) of the maximum dry density using the standard proctor test.

3.10 MISCELLANEOUS EXCAVATION

- A. The CONTRACTOR shall perform all the remaining miscellaneous excavation. The CONTRACTOR shall make all excavations necessary to permit the placing of loam and plants, for constructing roadways, and any other miscellaneous earth excavation required under this Contract.

3.11 DISPOSAL OF UNSUITABLE, WASTE, AND/OR SURPLUS EXCAVATED MATERIAL

- A. Unsuitable, waste, and surplus excavated material including, but not limited to, concrete pavement, asphalt pavement, driveways, sidewalks, and construction debris shall be removed and disposed of off-site in accordance with state and local regulations. Materials may be temporarily stockpiled in an area within the R-O-W limits that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restrict access to the site of the work.

3.12 GRADING

- A. Grading shall be performed to the lines and grades shown on the Drawings. All objectionable material encountered within the limits indicated shall be removed and disposed of. Subgrades shall be completely and continuously drained and dewatered throughout the grading process. Install temporary drains, drainage ditches, etc., to intercept or divert surface water which may affect the execution or condition of grading work.
- B. If, at the time of grading, it is not possible to place any material in its proper section of the work, it shall be stockpiled in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

- C. Stones or rock fragments larger than 4 inches in their greatest dimensions will not be permitted within the top 6 inches of the finished grade of fills and embankments.
- D. In cut areas, all loose or protruding rocks in slopes shall be removed to line or finished grade of the slope. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the Drawings, unless otherwise directed by the ENGINEER.

3.13 BASE COURSE

- A. Base course under asphalt concrete pavement shall be placed to the lines and grades shown on the drawing and compacted to 98 percent (98%) of maximum density as determined by ASTM D1557 Method D.
- B. Base course under non-roadway locations shall be placed as soon as practical after grading and compacting of the sub-base. Sub-base shall be compacted to 95 percent (95%) of maximum density as determined by ASTM D1557 Method D.

3.14 PROTECTION OF UTILITIES

- A. The CONTRACTOR shall adhere to all state underground dig laws.
- B. The CONTRACTOR shall locate and protect all utilities which could be affected by the work, including overhead cables, poles, buried cables, wastewater pipes, water pipes, drainage pipes, and appurtenances. Before working in any area, the CONTRACTOR shall contact the local utility locating service to mark the locations of underground utilities. Any underground utilities which could interfere with the work shall be staked and flagged.
- C. Underground pipes and cables which cross the excavations shall be carefully exposed and temporarily supported from overhead beams furnished by the CONTRACTOR to the satisfaction of the utility owner. The utility shall be carefully incorporated in the backfill with full support and protection. Utilities shall be relocated as required, at no additional cost to the OWNER.

3.15 MAINTENANCE

- A. CONTRACTOR shall maintain all project areas during the specified warranty period. Maintenance shall include the following:
 - 1. Immediately filling and reseeding any eroded areas.
 - 2. Reseeding or resodding any areas where a full stand of grass does not develop.

3. Removal and replacement of any trees which die or show distress, including stump removal.
4. Refilling and seeding or sodding any backfilled areas which settle and develop depressions.

END OF SECTION

SECTION 02260

SITE RESTORATION

PART 1 - GENERAL

1.01 CLEAN-UP

Upon completion of the installation of the structures, yard piping, equipment and appurtenances, the CONTRACTOR shall remove all debris and surplus construction materials resulting from his work. The CONTRACTOR shall grade the ground along each side of the culvert trench and/or structure in a uniform and neat manner leaving the construction area in a shape as near as possible to the original ground line.

PART 2 - PRODUCTS

2.01 SEEDING

All graded areas shall be seeded or sodded as specified in Section 02900 – Seeding and Sodding.

PART 3 - EXECUTION

3.01 SITE RESTORATION

- A. After installation of lines, the construction site will be restored to its original condition or better. All paved streets, roads, sidewalks, curbs, etc. removed or disturbed during construction shall be replaced, and all materials and workmanship shall conform to standard practices and specifications of the OWNER and/or to the Georgia Department of Transportation (GDOT) requirements and specifications, whichever applies. Gravel, cinder or dirt streets, drives and shoulders shall be replaced and sufficiently compacted to provide a surface suitable for carrying the type of traffic normally imposed at that location.
- B. All seeded areas shall be watered daily during the germination period, unless rain supplies the required moisture. The CONTRACTOR shall replace, at his own expense, trees, shrubs, etc. disturbed during construction.
- C. The CONTRACTOR shall remove from the site all equipment, unused materials and other items at his expense. The construction site shall be left in a neat, orderly condition, clear of all unsightly items, before the Work is finally accepted.

END OF SECTION

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SECTION 02270

EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The erosion and sedimentation controls shown on the Drawings are illustrative of potential requirements of the CONTRACTOR obtained erosion and sediment permit, but do not imply a fully complete system that would satisfy permit requirements. CONTRACTOR is responsible for providing effective erosion and sediment control measures during construction and shall furnish all labor, materials, equipment and incidentals necessary to prepare an erosion and sediment control plan, obtain an erosion and sediment control permit from the appropriate permitting agency, perform all installation, maintenance, removal and area cleanup related to sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, rock check dams, straw bale barriers, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, erosion control matting installation, and final cleanup.

1.02 RELATED WORK

- A. Section 02200: Earthwork.
- B. Section 01110: Environmental Protection Procedures.
- C. Section 02900: Seeding and Sodding

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, technical product literature for all commercial products to be used for sedimentation and erosion control.
- B. Submit an approved erosion and sediment control plan to the ENGINEER prior to initiating land disturbing activities.

1.04 REFERENCE STANDARDS

- A. The material and method of construction shall be in accordance with the Georgia Department of Transportation Specifications and Erosion and the Georgia Soil Water and Conservation Commission.

1.05 PERFORMANCE REQUIREMENTS

- A. The CONTRACTOR shall be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to off-site areas or into the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off-site shall be installed, maintained, removed, and cleaned up at the expense of the CONTRACTOR.
- B. Sedimentation and erosion control measures shall conform to the requirements of *The Manual for Erosion and Sediment Control in Georgia* (Green Book).
- C. Where CONTRACTOR'S efforts to control erosion have been demonstrated to be ineffective or potentially ineffective, in the opinion of the ENGINEER, the ENGINEER may order that the Erosion Control Plan be amended and that additional erosion control measures be constructed at no additional cost to the OWNER.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Coarse aggregate shall conform to National Stone Association (N.S.A.) classification and the Georgia Department of Transportation (GDOT).
- B. Rip rap for rock check dam stability shall be graded size 2" – 10" per N.S.A.
- C. Rip rap for rock construction exits shall be R-2 (1.5" – 3").
- D. Silt Fence
 - 1. Synthetic filter fabric shall be a pervious sheet of propylene, nylon, polyester or ethylene yarn and shall be certified by the manufacturer or supplier as conforming to the requirements noted in Table 1.
 - 2. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0° F to 120° F.
 - 4. Steel posts (standard "U" or "T" section) for silt fence construction, they must have a minimum weight of 1.33 pounds per linear foot and shall have a minimum length of 4 feet.

5. Wire fence reinforcement for silt fences using 36" GDOT approved fabric shall be a minimum of 14 gauge and shall have a maximum mesh spacing of 6 inches.
- D. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent (50%) by weight of material to be 10-inch or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.
- E. Latex acrylic copolymer, such as Soil Sealant with coalescing agent as manufactured by Soil Stabilization Co., Merced, California or equal shall be used as straw mulch tackifier.
- F. An asphalt tackifier shall only be used when temperatures are too low to allow the use of a latex acrylic copolymer and only with prior written approval from the ENGINEER.
- G. Hay-bales may be used as temporary check dams per *The Manual for Erosion and Sediment Control in Georgia* (Green Book).
- H. Curb inlet protection devices shall use gravel bags constructed by wrapping GDOT #57 stone with filter fabric, wire, plastic mesh, or equivalent material.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Silt Fence Installation
 1. Silt fences shall be positioned as shown on the approved Sediment and Erosion Control Plan and indicated on the Drawings and as necessary to prevent off-site movement of sediment produced by construction activities as directed by the ENGINEER. See Drawings for installation details.
 2. The height of a silt fence shall be a minimum of 28 inches above the original ground surface and shall not exceed 34 inches above ground elevation.
 3. The filter fabric shall be purchased in a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter cloth shall be spliced together only at a support post, with a minimum 6-inch overlap, and securely sealed.

4. A trench shall be excavated approximately 2-inches wide and 6-inches deep on the upslope side of the proposed location of the measure.
5. When wire support is used, standard-strength filter cloth may be used. Posts for this type of installation shall be placed a maximum of 6-feet apart. The wire mesh fence must be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches and shall not extend more than 34 inches above the original ground surface. The standard-strength fabric shall be stapled or wired to the wire fence, and 8 inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees.
6. When wire support is not used, extra-strength filter cloth shall be used. Posts for this type of fabric shall be placed a maximum of 6-feet apart. The filter fabric shall be fastened securely to the upslope side of the posts using one inch long (minimum) heavy-duty wire staples or tie wires and eight inches of the fabric shall be extended into the trench. The fabric shall not be stapled to existing trees. This method of installation has been found to more commonplace than #4.
7. If a silt fence is to be constructed across a ditch line or swale, the measure must be of sufficient length to eliminate end flow, and the plan configuration shall resemble an arc or horseshoe with the ends oriented upslope. Extra-strength filter fabric shall be used for this application with a maximum 3-foot spacing of posts.

All other installation requirements noted in Paragraph 3.01.A.5 apply.

8. The 2-inch by 6-inch trench shall be backfilled and the soil compacted over the filter fabric.
9. Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.

B. Rock Filter Dam Installation

1. Rock filter dams shall be positioned as indicated on the drawings or as necessary to prevent erosion of swales or ditches.
2. The center of the rock dam should be at least nine inches lower than the outer edges of the dam at the channel banks.
3. The side slopes shall be 2:1 or flatter.

4. Rock size shall be determined according to specifications set forth in Appendix C of the Green Book

C. Straw Bale Barrier Installation

1. Bales shall be placed around yard inlets with ends or sides of adjacent bales tightly abutting one another.
2. All bales shall be either wire-bound or string-tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.
3. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging), the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side of the barrier.
4. Each bale shall be securely anchored by a least two stakes (minimum dimensions 2 inches x 2 inches x 36 inches) or standard "T" or "U" steel posts (minimum weight of 1.33 pounds per linear foot) driven through the bale. The first stake or steel post in each bale shall be driven toward the previously laid bale to force the bales together. Stakes or steel pickets shall be driven a minimum 18 inches deep into the ground to securely anchor the bales.
5. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales. Loose straw scattered over the area immediately uphill from a straw bale barrier tends to increase barrier efficiency.
6. The filter cloth utilized shall be a woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns or polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant, and conform to the physical properties noted in Table 2.

D. Stone Construction Exit Installation

1. The stone construction exit shall be installed to meet the minimum required dimensions shown in the Drawings.

2. The area of the exit must be excavated a minimum of 3 inches and must be cleared of all vegetation, roots, and other objectionable material. The filter fabric underliner will then be placed the full width and length of the entrance.
3. Following the installation of the filter cloth, the stone shall be placed to the specified dimensions. If wash racks are used, they should be installed according to manufacturer's specifications. Any drainage facilities required because of washing should be constructed according to specifications. Conveyance of surface water under entrance, through culverts, shall be provided as required. If such conveyance is impossible, the construction of a "mountable" berm with 5:1 slopes will be permitted.
4. The filter cloth utilized shall be a woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns or polyester. The fabric shall be inert to commonly encountered chemicals and hydrocarbons, be mildew and rot resistant, and conform to the physical properties noted in Table 2.

E. Curb Inlet Protection

1. A gap of approximately 4 inches shall be left between the inlet filter and the inlet to allow for overflow and prevent hazardous ponding in the roadway.

F. Bypass-Pumping

1. The pump intake must be situated in a manner that prevents ingestion of streambed materials. The pump outlet must be discharged onto a stable, non-erodible material such as rip rap downstream of the work area.

3.02 MAINTENANCE AND INSPECTIONS

A. Inspections

1. CONTRACTOR shall make a visual inspection of all sedimentation control devices once per week and promptly after every rainstorm. If such inspection reveals that additional measures are needed to prevent movement of sediment to offsite areas or into the vent trench, CONTRACTOR shall promptly install additional devices as needed. Sediment controls in need of maintenance shall be repaired promptly.

B. Device Maintenance

1. Silt Fences

- a. Sediment deposits must be removed when deposits reach approximately one-half the height of the barrier.
- b. Should the fabric on a silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, the fabric shall be replaced promptly.
- c. Make other repairs as necessary to ensure that the fence is filtering all runoff drained to the fence.

2. Rock Filter Dams

- a. Sediment must be removed when it reaches one-half of the original height of the measure.

3. Straw Bale Barriers

- a. Sediment deposits must be removed when the level of deposition reaches approximately one-half the height of the barrier.
- b. Necessary repairs to the barriers or replacement of the bales shall be accomplished promptly.

4. Stone Construction Exit

The exit shall be maintained in a condition which will prevent tracking or flow of mud onto public rights-of-way. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. All materials spilled, dropped, washed, or tracked from vehicles onto roadways or into storm drains must be removed immediately. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

3.03 TEMPORARY MULCHING

- A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 14 days of the completion of rough grading.

- B. Straw mulch shall be applied at rate of 100 lbs/1000 ft² and tackified with latex acrylic copolymer at a rate of 1 gal/1000 ft² diluted in a ratio of 30 parts water to 1 part latex acrylic copolymer mix.

3.04 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized against erosion, remove sediment control devices. Dispose of waste materials in proper manner.
- B. Any sediment deposits remaining after the silt fence or straw bale barriers are removed shall be dressed to conform to the existing grade, prepared and seeded.
- C. Unless they will be incorporated into a permanent stormwater management control, check dams must be removed when their life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when they are no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed. The use of filter cloth underneath the stone will make the removal of the stone easier.

TABLE 1
 PHYSICAL PROPERTIES OF
 FILTER FABRIC IN SILT FENCE

TYPE FENCE	A	B	C
Tensile Strength (Lbs. Min.) (1) (ASTM D-4632)	Warp - 120 Fill - 100	Warp - 120 Fill - 100	Warp - 260 Fill - 180
Elongation (% Max.) (ASTM D-4632)	40	40	40
AOS (Apparent Opening Size) (Max. Sieve Size) (ASTM D-4751)	#30	#30	#30
Flow Rate (Gal/Min/Sq. Ft.) (GDT-87)	25	25	70
Ultraviolet Stability (2) (ASTM D-4632 after 300 hours weathering in accordance with ASTM D-4355)	80	80	80
Bursting Strength (PSI Min.) (ASTM D-3786 Diaphragm Bursting Strength Tester)	175	175	175
Minimum Fabric Width (Inches)	36	22	36

(1) Minimum roll average of five specimens.

(2) Percent of required initial minimum tensile strength.

TABLE 2
CONSTRUCTION SPECIFICATIONS
FOR GEOTEXTILE UNDERLINER

<u>Fabric Properties</u> ¹	<u>Light-Duty Entrance</u> ² (Graded Subgrade)	<u>Heavy-Duty Entrance</u> ³ (Rough Graded)	<u>Test Method</u>
Grab Tensile Strength (lbs.)	200	220	ASTM D1682
Elongation at Failure (%)	50	220	ASTM D1682
Mullen Burst Strength (lbs.)	190	430	ASTM D3786
Puncture Strength (lbs.)	40	125	ASTM D751 (modified)
Equivalent Opening Size (mm)	40-80	40-80	U.S. Standard Sieve CW-02215

- ¹ Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.
- ² Light Duty Entrance: Sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Examples of fabrics which can be used are: Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.
- ³ Heavy Duty Entrance: Sites with only rough grading and where most travel would be multi-axle vehicles. Examples of fabrics which can be used are: Trevira Spunbond 1135, Mirafi 600X, or equivalent.

END OF SECTION

SECTION 02500

ROADWAYS, MARKINGS, GUARD RAILS AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION OF THE WORK

Extent of asphaltic pavement paving is shown on the Drawings, including roads, driveways and parking areas.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Unless noted, all specification designations refer to the Georgia Department of Transportation (GDOT) Standard Specifications, latest Edition. Appropriate portions of the referenced sections of the Specifications shall apply, but all work shall be included in lump sum bid items described herein unless otherwise specified or shown on the Drawings.
- B. Preparation of subbase is specified in this Division, Section 02200.
- C. Crushed stone and dense graded aggregate are specified in this Division, Section 02200.

1.03 QUALITY ASSURANCE

- A. Performance: Asphaltic seal coat that fails as the result of not meeting the requirements of these Specifications shall be corrected at the CONTRACTOR'S expense.
- B. The design plant mix shall be submitted to the ENGINEER for review and acceptance. The submittal shall include the last date the mixture was approved by GDOT for use on a state road project; and the location where the mixture was recently used, and the name and address of the paving contractor.

PART 2 - PRODUCTS

2.01 ASPHALTIC CONCRETE SURFACE MATERIAL

- A. Aggregates shall meet the applicable requirements of the GDOT.

- B. Asphaltic materials shall meet the applicable requirements of the GDOT.
- C. Asphaltic materials for tack coat shall conform to the requirements of Section 413 of GDOT.
- D. Steel, wood or other suitable material shall be of size and strength necessary to resist movement during asphaltic placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects.
- E. Temporary pavement shall be “cold mix”, conforming to the requirements of Section 401 of GDOT. Temporary pavement shall be placed over a backfilled trench promptly after completion of the backfilling. Repaving may be delayed if the OWNER and ENGINEER so directs, but in such case temporary pavement replacement shall be required in cross streets and heavily traveled roads, etc. as directed by the OWNER and ENGINEER.

2.02 ASPHALTIC SEAL COAT MATERIAL

- A. Coarse aggregate shall be GDOT Standard Size No. 8, meeting applicable requirements of Section 800 of GDOT.
- B. Asphaltic materials shall meet applicable requirements of Section 400 of GDOT.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

The road shall be swept with an approved mechanical sweeper and with wire hand brooms, when necessary. Special care shall be taken to clean the edges of the surface so that full width of the roadway to be treated shall be uniformly clean. Where any mud or earth exists, it shall be removed sufficiently in advance of application of asphaltic material to allow the surface to become thoroughly dry.

3.02 CUTTING PAVEMENT

- A. Existing asphaltic pavements to be removed shall be cut by a wheel cutter, clay spade, or other device capable of making a neat, reasonably straight and smooth cut without damaging adjacent pavement that is not to be removed.

- B. The existing pavement shall be saw cut and trimmed after placement of required base course material and just prior to placement of asphaltic concrete for pavement replacement, and the trimmed edges shall be painted with a coating of prime coat immediately prior to constructing the new abutting asphaltic pavements. No extra payment shall be provided for these items, and all costs incurred in performing this work shall be incidental to underground utility construction or pavement replacement.
- C. All removed asphaltic pavement material is the property and disposal responsibility of the CONTRACTOR.

3.03 ASPHALTIC CONCRETE PAVING

- A. Composition of Mixtures: Surface pavement mixture, meeting requirements of the GDOT shall be used as determined by local plant mix availability. The mixture shall have been approved recently by GDOT, used recently on a state project, and conform to the requirements below when tested in accordance with ASTM D 1559-76:

Stability, minimum pounds	1200
Flow, 0.01 inch	Min. 6, Max. 16
Percent air voids	Min. 4, Max. 8
Minimum voids in mineral aggregate,	
percent: 3/4 inch	14
1 inch	13

- B. Construction Methods: Construction requirements shall conform to applicable requirements of the GDOT.
- C. A tack coat shall be required to bond new paving to the surface of concrete or brick pavements and bases or existing asphaltic surfaces. It shall be applied in accordance with Section 413 of GDOT.
- D. Where asphaltic paving is placed against vertical surfaces such as curbs, gutters, manhole frames, valve boxes, etc., the vertical face shall be tack coated to seal the surface. Where these surfaces are inaccessible to pressure distributor, the tack coat may be brushed or broomed into place. The tack coat shall not be allowed to spill over onto any horizontal surface outside the area to be paved.
- E. When asphaltic pavement is applied over existing pavement, existing surfaces adjoining gutters and other permanent features shall be ground to create smooth transitions and to maintain surface water flow lines.

- F. Spreading shall be as nearly continuous as possible. At terminations of new surface course, the asphaltic pavement shall be feathered into the existing surface over such a distance as may be required to produce a smooth riding transition. Existing pavements to be over-laid shall be ground or removed as required to avoid feather edges less than 1-inch in depth.
- G. Unless otherwise indicated on the Drawings or in these Specifications, the compacted thickness of the asphaltic concrete paving shall be a minimum of 2 inches and the minimum ambient temperature for placing shall be 40° F. Mixing and laying temperatures shall be as follows:

Aggregates	Min. 240° F Max. 325° F
Asphalt Cement	Min. 225° F Max. 325° F
Mixture at Plant	
(measured in truck)	Min. 240° F Max. 325° F
Mixture when Placed	
(measured in truck when discharging)	275° ± 20° F**

**The 275° F + 20° F mixture placing temperature is based on 275° F being about the ideal temperature for obtaining optimum compaction under average conditions. However, when the distance between asphalt plant and the job is such that specified placing temperatures cannot be maintained even though maximum mixing temperatures are covered, insulated hauling equipment as described below are used, the minimum placing temperature shall be 225° F.

- H. Trucks for hauling asphaltic mixtures shall have tight, clean and smooth metal beds that have been sprayed with a minimum amount of soap emulsion, paraffin oil, or other approved material that is not detrimental to the mixture to prevent the mixture from adhering to the beds. All trucks shall be equipped with covers of sufficient size to completely cover the located material and all covers shall be securely fastened in place before the truck leaves the plant. Truck beds shall be insulated, when necessary, to maintain the specified temperature to the point of delivery. Any truck causing excessive segregation of material by its spring suspension or other contributing factors shall be discharged from the work until such conditions are corrected.
- I. The CONTRACTOR shall have an accurate thermometer on the job at all times for verifying all temperature requirements and for taking temperature measurements whenever requested by the ENGINEER or OWNER. The CONTRACTOR shall closely control temperature and compaction requirements to achieve quality asphaltic paving and related work.

- J. The finished surface shall be of uniform texture. When tested with a 10-foot straightedge laid on the surface parallel with the centerline of the road, the variation of the surface from the testing edge of the straightedge shall not be more than 1/4-inch except at grade changes.
- K. Asphaltic paving that fails as the result of not meeting the requirements of these Specifications shall be removed and replaced at the CONTRACTOR'S expense.
- L. In all case, the CONTRACTOR will be required to maintain, without additional compensation, all permanent replacement of street paving, performed under this Contract until accepted by the OWNER, including the removal and replacement of such work wherever surface depressions or underlying cavities result from settlement of trench backfill.
- M. Where directed by the OWNER and ENGINEER, the CONTRACTOR shall place asphaltic surface course pavement over the entire paved traveled way. The final pavement shall be constructed in accordance with GDOT and the City of Griffin.
- N. The CONTRACTOR shall take all precautions to avoid tracking tack coat or asphaltic pavement onto existing road surfaces outside the area to be paved.

3.04 ROADWAY SURFACE REMOVAL

- A. All pavement cuts shall be neat and straight to provide an unfractured and level pavement joint for bonding existing surfacing with pavement replacement. Pavement cuts shall be parallel or at right angles to the road or area centerlines. All cut edges shall provide clean, solid, vertical faces free from all loose material.
- B. No pavement shall be machine pulled until completely broken and separated along the marked cuts.
- C. The pavement adjacent to the pipeline trenches shall neither be disturbed nor damaged. If the adjacent pavement is disturbed or damaged, irrespective of cause, the CONTRACTOR shall remove the damaged pavement and shall replace it at his own expense.
- D. All existing crushed aggregate and asphaltic concrete removed, and any excess new material shall be hauled away from the project site and legally disposed of by the CONTRACTOR.

3.05 RESURFACING

- A. In all existing pavement areas where the surface is removed, broken or damaged by CONTRACTOR'S equipment or in which the ground has caved in or settled due to the installation of the improvements, or areas designated to be repaved, resurfaced, or modified, the surface shall be restored to the original grade by the CONTRACTOR. Prior to resurfacing, the existing surfacing shall be removed as provided above. All broken and jagged edges of the pavement edge shall be straight. Areas to be cut shall be indicated until these edges have been sawed. If during the initial removal of the existing pavement a method of removal was used which disturbed the adjoining pavement, or if during general construction operations the adjacent pavement was disturbed, then this adjoining pavement must also be removed and replaced. Where irregular surfaces are to be surfaced, existing pavement shall be cut parallel to the alignment of the pipe or to the centerline of the roadway. Asphaltic pavement shall be saw cut to a minimum depth of 2-inches at a point not less than 6-inches outside the limits of excavation or the previous pavement cut (made by pneumatic tools), whichever limits are the greater. The additional surfacing so cut shall be removed and disposed of by the CONTRACTOR prior to resurfacing.
- B. Restoration of asphaltic pavement shall be to the same section as the existing roadway/paved area or a minimum thickness of 2-inches, whichever is greater.
- C. Wherever asphaltic pavement does not terminate against a curb, gutter, or another pavement, the CONTRACTOR shall provide and install a ground contact rated, pressure treated hem-fir, No. 2 or better, 2x6 header board, securely staked and fastened in place.

3.06 TEMPORARY PAVEMENT

- A. Where directed by the ENGINEER, the CONTRACTOR shall place temporary pavement to a thickness of 4-inches with top matching the grade of existing pavement. The material shall be temporary patching "cold mix". Temporary pavement shall be maintained until replaced by permanent pavements.

3.07 MISCELLANEOUS RESTORATION

- A. Refer to Section 02515 for replacement of concrete walkways. Concrete curb or curb gutter shall be restored to the existing height and cross section in full sections or lengths between joints. Concrete shall be as specified on the Drawings. Grassed yards, shoulders and parkways shall be restored to match the existing sections with sod of a type matching the existing grass.

B. Concrete Driveways:

1. Portland cement concrete driveways shall be placed with nonstructural concrete having a minimum compressive strength of 3,000 psi according to the applicable portions of the GDOT Standard Specifications. The minimum thickness shall be 6-inches with 6x6x10x10 welded wire fabric reinforcement embedded with the concrete. Expansion material shall be placed in the joint between old and new concrete. Saw joints shall be placed as approved by the ENGINEER.

C. Asphalt Driveways:

1. Asphalt driveways shall be repaired with an asphaltic concrete surface course. Asphaltic concrete repair shall consist of minimum of 6-inches or the thickness of the existing base material, whichever is greater. The repair shall extend a minimum of 2-feet wider than the top of the trench and to the depth of the existing driveway. When the existing driveway had a seal coat to form boards, the CONTRACTOR shall match the existing construction.

D. Other Driveways:

1. In chip and seal, oil-mat epoxy sealed and gravel pavements, decorative driveways, wearing surfaces shall be replaced with the same or better kind of quality material as that removed or damaged. The repair shall extend a minimum of 2-feet wider than the top of the trench and to the depth of the existing driveway. The repair shall be to the satisfaction of the owner.

- E. Any driveway affected by construction shall be repaired in sections, rather than patched, in a manner consistent with the original construction of the driveway. The original driveway shall be cut back to a straight vertical transverse joint or to an existing joint as approved by the ENGINEER. New driveways will be placed to the edge of the road and as shown on the Drawings.

3.08 PAVEMENT MARKING REPAIR

- A. Reline all streets with pavement markings equal in type and location where existing prior to paving.

3.09 GUARDRAILS

- A. Where temporarily removing existing guardrails to perform the work, replace the guardrails to match existing.

END OF SECTION

SECTION 02515

CONCRETE WALKWAYS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install concrete walkways, pads and pond aprons as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Earthwork is included in Section 02200.
- B. Seeding is included in Section 02900.
- C. Concrete work is included in Section 03100.

1.03 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- B. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M213 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete shall be as specified in Section 03100, but in no case less than 3,500 psi at twenty-eight (28) days.

- B. Welded wire fabric shall conform to ASTM A185 and shall be of size and gauge shown.
- C. Expansion joint filler shall be bituminous type, 1/2-inch thick meeting AASHTO M-213-65.
- D. Materials for gravel base course shall be as specified in Section 02200.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The subgrade for walkways shall be shaped parallel to the proposed surface of the walkways and thoroughly compacted. All depressions occurring shall be filled and again compacted until the surface is smooth and hard.
- B. After the subgrade has been prepared, a gravel base course shall be placed. After being thoroughly compacted, the base course shall be at least 8-inches in thickness and parallel to the proposed surface of the walkway.
- C. Forms
 - 1. Side and transverse forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the walkway and of a type satisfactory to the ENGINEER.
 - 2. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with their upper edge conforming to the grade of the finished walk which shall have sufficient pitch to provide for surface drainage, but not to exceed 1/4-in/ft.
- D. Wire Fabric Reinforcement
 - 1. All wire fabric shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious coatings.
 - 2. Splices in welded wire fabric shall be lapped not less than 1-1/2 courses or 12-inches, whichever is greater. Wire fabric splices shall be tied together with wire ties as approved spaced no more than 24-inches on center. Support as approved in middle of slab.

3. Before being placed in position, wire fabric shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, fabric shall be re-inspected and cleaned when necessary.
4. In no case shall wire fabric be covered with concrete until the amount and position of the fabric have been checked by the ENGINEER and his/her permission given to proceed with the concreting.

E. Placing and Finishing Concrete

1. Concrete walkways shall be placed in alternate slabs not exceeding 30-feet in length, except as otherwise ordered. The slabs shall be separated by transverse, preformed expansion joint filler.
2. Preformed expansion joint filler shall be placed adjacent to structures as directed.
3. Concrete shall be placed in such quantity that, after being thoroughly consolidated in place, it shall be 4-inches in depth. Finishing operations shall be delayed until all bleed water and water sheen has left the surface and concrete has started to stiffen. After water sheen has disappeared, edging operations shall be completed. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. Finish with broom at right angles to alignment of walk, then round all edges with 1/4-inch radius after brooming.
4. When completed, the walkways shall be kept moist and protected from traffic and weather for at least three (3) days.

END OF SECTION

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SECTION 02610

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required and install, test, and ready for operation all ductile iron pipe and fittings for the water main as shown on the Drawings and as specified herein.
- B. Piping shall be located substantially as shown on the Drawings. The ENGINEER reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the CONTRACTOR'S convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.
- C. Where the word "pipe" is used it shall refer to pipe, fittings, and appurtenances, unless otherwise noted.

1.02 RELATED WORK

- A. Section 01300: Submittals.
- B. Section 2140 Dewatering
- C. Section 02200: Earthwork.
- C. Section 02270: Erosion and Sediment Control.
- E. Section 02500: Roadways, Markings, Guardrails, and Appurtenances.

1.03 SUBMITTALS

- A. Submit to the ENGINEER, in accordance with Section 01300, shop drawings and product data for review.
- B. Submit copies of design calculations in accordance with Paragraph 2.02 below.

- C. Submit a tabulated laying schedule which references stations and invert elevations as shown on the Drawings, as well as all fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves, and specials along with the manufacturer's drawings and specifications indicating complete details of all items. The laying schedule shall show pipe class, class coding, station limits, and transition stations for various pipe classes. The above shall be submitted to the ENGINEER for approval before manufacture and shipment. The location of all pipes shall conform to the locations indicated on the Drawings. Pipe shall not be supplied from inventory.
- D. Submit anticipated production and delivery schedule.
- E. Prior to shipment of pipe, submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings, and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.
- F. Submit pipe testing plan in accordance with Paragraph 3.03.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A193 – Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 - 2. ASTM A194 – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
 - 3. ASTM C150 – Standard Specification for Portland Cement.
- B. American Water Works Association (AWWA)
 - 1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-In Through 48-In (75mm Through 1200mm) for Water and Other Liquids.
 - 4. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. AWWA C150 – Thickness Design of Ductile-Iron Pipe.
 6. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 7. AWWA C600 – Installation of Ductile Iron Water Mains and heir Appurtenances.
 8. AWWA C651 – Ductile Iron Pipe, centrifugally cast, for water.
- C. Where reference is made to one of the above standards, the revision in effect at the time of Bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Each length of ductile iron pipe supplied for the project shall be hydrostatically tested at the point of manufacture to 500 psi for a duration of 10 seconds, per AWWA C151. Testing may be performed prior to machining bell and spigot. Failure of ductile iron pipe shall be defined as any rupture of the pipe wall. Certified test results shall be furnished in duplicate to the ENGINEER prior to time of shipment.
- B. All ductile iron pipe and fittings to be installed under this project shall be inspected and tested at the foundry as required by the standard specifications to which the material is manufactured. Furnish in duplicate to the ENGINEER sworn certificates of such tests and their results prior to the shipment of the pipe.
- C. All pipe and fittings to be installed under this Contract may be inspected at the plant for compliance with this section by an independent testing laboratory selected by the OWNER at the OWNER'S expense.
- D. Inspection of the pipe and fittings will also be made by the ENGINEER or representative of the OWNER after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

E. All pipe and fittings shall be permanently marked with the following information:

1. Manufacturer, Date.
2. Size, Type, Class, or Wall Thickness.
3. Standard Produced to (AWWA, ASTM, etc.).

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe. Under no circumstances shall the pipe be dropped or skidded against each other. Slings, hooks, or pipe tongs shall be used in pipe handling.
- B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times.
- C. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.
- D. Gaskets for mechanical and push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Pipe

1. Ductile iron pipe shall conform to AWWA C151. Pipe shall be supplied in standard lengths as much as possible.
2. Thickness design shall be per AWWA C150, except provide minimum class as indicated on the Drawings. The minimum class for the water main shall be Class 350 psi.
3. Ductile iron pipe shall be manufactured by U.S. Pipe and Foundry Company Inc., American Cast Iron Pipe Company, Clow, Griffin, or equal.

B. Joints

1. Ductile iron pipe shall have rubber-gasket pushon or rubber-gasket mechanical joints conforming to AWWA C111. Gaskets shall be styrene butadiene (SBR). Restrained joint piping shall be as shown on the Drawings.
2. Restrained joints for pipes 12-inches and smaller, except where in the joint type is shown, may be push-on joints with special restraining gaskets. Such gaskets shall utilize stainless steel wedges embedded in the gasket and stainless steel restraining rings in the pipe bells designed to force the wedges into the pipe spigot to prevent withdrawal of the spigot from the bell. Approved restraining gaskets are U.S. Pipe Field Lok 350 Gasket and American Fast-Grip Gasket. Fittings for such pipe may utilize mechanical joints with restrained glands as specified below.
3. The required lengths of restrained joint pipe shall be as shown on the Drawings.

C. Fittings

1. Pipe fittings shall be ductile iron and shall be restrained with pressure rating of 350 psi for sizes 12-inches and smaller. Fittings shall meet the requirements of AWWA C110 or AWWA C153 as applicable. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.
2. Restrained Mechanical Joint Fittings:
 - a. Mechanical joints shall be restrained through the use of a follower gland.
 - b. Restrained mechanical joint glands shall be Megalug as manufactured by EBAA Iron, Inc. or equal.
 - c. Restrained glands shall be factory prepared and coated with a polyester based coating equal to EBAA Iron, Inc. Mega-Bond. The restrained wedges and assembly shall be coated with a compatible protective coating. Bolts shall be coated cor-ten steel.
2. Closures shall be made with mechanical joint ductile iron solid sleeves and shall be located in straight runs of pipe at minimum cover outside the limits of restrained joint sections. Location of closures shall be subject to approval of the ENGINEER. All adaptor couplings are to be solid sleeve.
3. Ductile iron pipe shall transition to in-line valves and branch pipes with mechanical joints. Restrained joint by plain-end transition pipes shall be ductile iron and shall have mechanical joint solid sleeve couplings with restraining glands to permit future valve removal. Bolts shall be coated before the joint is made up.

D. Surface Preparation and Shop Coating

1. The interior of the pipe shall be cement mortar lined with bituminous seal coat in accordance with ANSI/AWWA C104/A21.4. Thicknesses of the lining shall be set forth in the aforementioned specification unless otherwise directed by the Engineer. The exterior of all pipe, unless otherwise specified, shall receive either coal tar or asphalt base coating a minimum of 1 mil thick.
2. All buried ductile iron pipe shall have manufacturer's outside coal tar or asphaltic base coating and a cement lining and bituminous seal coat on the inside.
3. Exterior finishes for ductile iron pipe and fittings shall have a bituminous outside coating in accordance with AWWA C151 and C110.

PART 3 - EXECUTION

3.01 GENERAL

- A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe or coatings. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece shall be installed which is found to be defective. Damage to the pipe coatings shall be repaired per manufacturer's recommendations.
- B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying; shall be kept clean until they are used in the work; and, when installed or laid, shall conform to the lines and grades required.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even, bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Blocking will not be permitted. The trench shall be dewatered to allow installation in the dry. Excavation, backfilling, and compaction shall be in accordance with the requirements of Section 02200.
- B. All pipe shall be sound and clean before laying. When installation is not in progress, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed 75 percent (75%) of allowable deflection recommended by manufacturer.

- C. All ductile iron pipe laid underground shall have a minimum of 48 inches of cover, unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid such that the invert elevations shown on the Drawings are not exceeded.
- D. Fittings, in addition to those shown on the Drawings, shall be provided where required in crossing utilities which may be encountered upon opening the trench. Solid-sleeve closures shall be installed at locations approved by the ENGINEER.
- E. The pipe interior shall be maintained dry and broom clean throughout the construction period.
- F. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end. Coatings shall be undamaged. Field-cut ends shall be sealed with approved epoxy for potable water in accordance with manufacturer's instructions. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field-adaptable restrained joints.
- G. Jointing Ductile Iron Pipe
 - 1. Pushon joints shall be made in strict accordance with manufacturer's instructions and AWWA C600. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home.
 - 2. Mechanical joints shall be assembled in strict accordance with the manufacturer's instructions and AWWA C600. Pipe shall be laid with bell ends looking ahead. To assemble the joints in the field, thoroughly clean and lubricate the joint surfaces and rubber gasket. Bolts shall be tightened to the specified torques. Under no condition shall extension wrenches or pipe over handle of ordinary ratchet wrench be used to secure greater leverage.
 - 3. Bolts in mechanical or restrained joints shall be tightened alternately and evenly.
 - 4. Restrained joints shall be installed as specified in Paragraph 2.01.B, according to pipe manufacturer's instructions.
- H. All blowoffs, outlets, valves, fittings, and other appurtenances required shall be set and jointed as indicated on the Drawings and in accordance with the manufacturer's instructions.
- I. All fittings shall be located with sub-meter accuracy GPS technology after they are installed and before they are backfilled. An electronic copy of this information shall be submitted with the record drawings.

3.03 TESTING

- A. After installation, but prior to connection to existing distribution and transmission mains, the pipe shall be tested for compliance as specified herein. Furnish all necessary equipment and labor for the pressure test and leakage test on the pipelines.
- B. Submit detailed test procedures and method for ENGINEER'S review. In general, testing shall be conducted in accordance with AWWA C600.
- C. Pressure pipelines shall be subjected to a hydrostatic pressure of 1.5 times the working pressure at the lowest point along the test segment or 150 psi, whichever is greater. This test pressure shall be maintained for a minimum of two (2) hours. The leakage rate shall not exceed those indicated in AWWA C600. Provide suitable restrained bulkheads as required to complete the hydrostatic testing specified.
- D. All valves and valve boxes shall be properly located and installed and operable prior to testing. Bulkheads shall be provided with a sufficient number of outlets for filling and draining the line and for venting air.
- E. Hydrostatic pressure and leakage tests shall conform with Section 4 of AWWA C600. Furnish gauges, meters, pressure pumps, and other equipment needed to fill the line slowly and perform the required hydrostatic pressure leakage tests.
- F. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the CONTRACTOR. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.
- G. Duration of pressure test shall not be less than two (2) hours. The leakage test shall be a separate test following the pressure test and shall not be less than two (2) hours in duration. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines which fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be removed and replaced.
- H. Submit plan for testing to the ENGINEER for review at least ten (10) days before starting the test.

3.04 CLEANING

- A. The CONTRACTOR shall use a removable watertight plug to prevent any dirt or debris from entering the pipe during construction. At the conclusion of the work, the CONTRACTOR shall thoroughly clean the entire pipe by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. All debris shall be removed from the pipeline. The lowest segment outlet shall be flushed last to assure debris removal.

3.09 FINAL DISINFECTION FOR POTABLE AND RECLAIMED WATER PIPELINES

- A. Before any portion of the potable and reclaimed water piping systems is to be placed in service, it shall be disinfected; and its disinfection shall be demonstrated by bacteriological tests conducted in accordance with "Standard Methods for Examination of Water and Sewage" for the coli-aerogenes group, by an approved laboratory, acceptable to the ENGINEER and GAEPD.
- B. All pipe, fittings, valves, and all other appurtenances installed for potable and reclaimed water lines shall be disinfected prior to being placed in service. Disinfection procedures shall be approved by the ENGINEER and shall be in conformance with ANSI/AWWA C651, latest revision.
- C. Pipe subjected to contaminating materials shall be treated in a manner approved by the ENGINEER. Should such treatment fail to remove contaminants from the pipe, contaminated sections of pipe shall be replaced with new uncontaminated pipe at no additional cost to the OWNER.
- D. Disinfection of a completed line shall be accomplished using the following procedure:
 - 1. All potable and reclaimed piping, fittings, valves, and appurtenances shall be disinfected with a chlorine solution with a sufficient concentration such that the initial chlorine concentration in the water line shall be a minimum of 50 mg/l available chlorine, at any point in the line.
 - 2. Chlorine used for the purpose of disinfection shall be high test granular calcium hypochlorite which contains approximately 65 to 70 percent (65%-70%) available chlorine by weight. The calcium hypochlorite shall be stored in a cool, dry, and dark environment, prior to its use, to minimize deterioration. The dry calcium hypochlorite will be used to make a high concentration chlorine solution which will be used for disinfection. Under no circumstances shall undiluted, dry calcium hypochlorite be placed in the pipeline to be disinfected.
 - 3. Water from the existing, in-service water line shall be made to flow at a constant, slow rate into the water line to be disinfected. Chlorine solution shall be injected or pumped at a regulated rate into the new main, at a point not more than 10 feet downstream from the

- beginning of the new water main. The method of tapping the water main for the chlorine injection point and the location of the tap shall be approved by the ENGINEER.
4. Chlorine solution shall be circulated in the water main by opening the water control valve and systematically manipulating valves and blowoffs.
 5. Water service lines shall be disinfected in a manner that is similar to that for water mains by methods acceptable to the ENGINEER.
 6. Chlorine solution shall remain in the reclaimed lines for no less than 24 hours, but longer than 24 hours if directed by the ENGINEER.
 7. Extreme care shall be exercised at all times to prevent concentrated chlorine solution from entering existing water mains.
- E. After 24 hours, the free residual chlorine concentration in the potable and reclaimed line at the pipe extremities shall be at least 10 mg/l; if not, the water lines shall be re-disinfected as described above.
- F. Final flushing of lines may proceed after 24 hours, provided the free residual chlorine analysis is satisfactory. Flushing shall be continued until a chlorine residual test shows that lines contain only the normal chlorine residual. Prior to flushing water with high chlorine concentrations, obtain approvals from the ENGINEER and the OWNER as to the methods and locations of discharge.
- G. Following disinfection and thorough flushing of the reclaimed lines, as specified herein, the CONTRACTOR shall furnish all labor and materials required to obtain samples of water from established points of the water line in suitable sterilized containers obtained from an approved analytical laboratory. Two (2) series of successive samples shall be obtained at each established sampling point. Each test series will require two (2) samples at each sampling point. The period between each series of samples shall be a minimum of 24 hours. Samples shall be delivered by the CONTRACTOR to an approved analytical laboratory for bacteriological examination. Samples shall be collected in conformance with GAEPD standards. Prior to collecting samples, the CONTRACTOR shall notify the ENGINEER and the OWNER.
- H. Bacteriological test results will be available approximately 48 to 72 hours after samples are submitted. If tests results are unsatisfactory, the CONTRACTOR shall immediately rechlorinate and retest the water lines and proceed with such corrective measures as are necessary to secure disinfected lines. All services shall be rechlorinated if the lines are rechlorinated. The water lines shall be re-disinfected and retested, at the CONTRACTOR'S expense, until approved by the OWNER, ENGINEER, and GAEPD.
- I. After satisfactory completion of the bacteriological test requirements, and subsequent regulatory agency approval, potable water lines shall be placed in service in a manner approved by the ENGINEER and the OWNER.

3.10 TESTING OF GRAVITY SEWER LINES

- A. After the gravity piping system has been brought to completion, and prior to final inspection, the CONTRACTOR shall rod out the entire system by pushing through each individual line in the system, from manhole to manhole appropriate tools for the removal from the lines of any and all dirt, debris, and trash. If necessary during the process of rodding the system, water shall be turned into the system in such quantities to carry off the dirt, debris and trash.
- B. During the final inspection, the ENGINEER will inspect each individual line, from manhole to manhole, either by use of lights, television or other means at his disposal to determine whether the completed lines are true to line and grade as laid out or as shown on the Drawings.

1. Deflection Test

- a. The ENGINEER may require deflection tests be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system.
 - b. No pipe shall exceed a deflection of 5 percent (5%). If deflection exceeds 5 percent (5%), replacement or correction shall be accomplished at the CONTRACTOR'S expense.
 - c. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent (95%) of the base inside diameter or of the pipe. The pipe shall be measured in compliance with ASTM D 2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices. The CONTRACTOR shall thoroughly clean the line prior to the deflection test.
- C. The pipe line shall be made as nearly watertight as practicable, and leakage tests and measurements shall be made if required by the ENGINEER. The CONTRACTOR shall be responsible for providing temporary wastewater collection and disposal until a satisfactory leakage test is obtained. All apparatus and equipment required for testing shall be furnished by the CONTRACTOR and the cost shall be included in the bid.
- 1. The ENGINEER may require the CONTRACTOR to smoke test the first section (manhole to manhole) of each size of pipe and type of joint prior to backfilling, to establish and check laying and jointing procedures. The test shall consist of smoke blown into closed-off sections of sewer under pressure and observing any smoke coming from the pipe line indicating the presence of leaks. Other supplementary smoke tests prior to backfilling may be performed by the CONTRACTOR at his option; however, any such tests shall not supplant the final tests of the completed work unless such final tests are waived by the ENGINEER.

2. Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the CONTRACTOR shall conduct either infiltration tests or low pressure air test on the completed pipeline.
 3. Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the CONTRACTOR shall conduct either exfiltration tests or low pressure air tests on the completed pipeline.
- D. Low pressure air tests shall be made using equipment specifically designed and manufactured for the purpose of testing sewer lines using low pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal pressure in the pipeline cannot exceed 8 psig. Testing shall be in accordance with ADSTM F1417.
1. The test shall be made on each manhole-to-manhole section of pipeline after placement of the backfill. The ENGINEER or his designated representative must be present to witness each satisfactory air test before it will be accepted as fulfilling the requirements of these specifications.
 2. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 3. Low pressure air passing through a single control panel, shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, the CONTRACTOR shall conduct only an infiltration test.
 4. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

<u>Pipe in Diameter</u> <u>in Inches</u>	<u>Minutes</u>
4	2.5
6	4.0
8	5.0
10	6.5
12	7.5
15	9.5

5. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.
- E. Infiltration tests shall be made after underdrains, if present, have been plugged and other groundwater drainage has been stopped such that the groundwater is permitted to return to its normal level insofar as practicable.
1. Upon completion of a section of the pipeline, the line shall be dewatered and a satisfactory test conducted to measure infiltration for at least 24 hours. The amount of infiltration, including manholes, tees and connections, shall not exceed 25 gallons per nominal inch diameter per mile of sewer per 24 hours.
 2. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
- F. Exfiltration tests which subject the pipeline to an internal pressure, shall be made by plugging the pipe at the lower end and then filling the line and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures which would cause leakage at the plugs or stoppers in branches, provisions shall be made by suitable ties, braces and wedges to secure the plugs against leakage resulting from the test pressure.
1. The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.
 2. Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.
- G. The CONTRACTOR shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests. Suitable bulkheads shall be installed, as required, to permit the test of the sewer. The CONTRACTOR shall construct weirs or other means of measurements as may be necessary.
- H. Should the sections under test fail to meet the requirements, the CONTRACTOR shall do all work of locating and repairing the leaks and retesting as the ENGINEER may require without additional compensation.
- I. If in the judgment of the ENGINEER, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the ENGINEER, but in any event, the CONTRACTOR shall be responsible for the ultimate tightness of the line within the above test requirements.

END OF SECTION

SECTION 02640

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and provide all buried valves, valves in manholes and underground vaults, and appurtenances complete with all accessories as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Excavation, backfill, fill and grading are included in Section 02200.
- B. Concrete is included in Division 3.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, materials required to establish compliance with this Section for shop drawings. Submittals shall include the following:
 - 1. Manufacturer's literature, illustrations, specifications and engineering data including:
 - a. Dimensions.
 - b. Size.
 - c. Materials of construction.
 - d. Weight.
 - e. Protection coating.
- B. Test Reports
 - 1. All certified shop test results specified herein.
- C. Operation and Maintenance Manuals
 - 1. Submit complete operation and maintenance manuals including copies of all approved Shop Drawings.

D. Certificates

1. Certificates of compliance where required by referenced standards: For each valve specified to be manufactured and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required tests and certification of proper installation.

1.04 REFERENCE STANDARDS

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

B. American Water Works Association (AWWA)

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron and Pressure Pipe and Fittings.
2. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.
3. AWWA C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
5. AWWA C800 – Underground Service Lines and Fittings.

C. American National Standards Institute (ANSI)

1. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.

D. American Society for Testing and Materials (ASTM)

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.

E. The Society for Protective Coatings (SSPC)

1. SSPC SP-6 - Joint Surface Standard Commercial Blast Cleaning.

- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications

1. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least ten (10) years. If required, the manufacturer shall furnish evidence of installation in satisfactory operation.
2. All units of the same type shall be the product of one manufacturer.

B. Design Criteria

1. All valves and appurtenances shall be new and in perfect working condition. Valves shall be designed for continuous use with a minimum of maintenance and service required and shall perform the required function without exceeding the safe limits for stress, strain or vibration. In no case will used or damaged valves be acceptable. The selection of equipment to meet the specified design conditions is the responsibility of the CONTRACTOR. Both workmanship and material shall be of the very best quality and shall be entirely suitable for the service conditions specified.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the work.
- B. Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.
- C. Store equipment to permit easy access for inspection and identification. Any corrosion in evidence at the time of OWNER acceptance shall be removed, or the valve shall be removed from the job.
- D. Store all equipment in covered storage off the ground.

1.07 COORDINATION

- A. Review installation procedures under other Sections and coordinate with the work which is related to this Section including buried piping installation, site utilities, piping insulation, heating, ventilating and air conditioning, plumbing and chemical feed facilities.
- B. Coordinate the location and placement of concrete thrust blocks when required.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Valves shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.
- C. Valves shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on some appropriate part of the body.
- D. Valves shall be supplied with shutoff gate valves, Valves shall be screwed and bronze, solid wedge, rising-stem type, rated for 200 psi non-sock working pressure. Valves shall be properly vented and piped to drain.
- E. Valves shall be pressure rated to be at least equal to the attached pipe's rating.
- F. When shown on the plans or in the valve schedule, the air release valve shall be supplied with backflushing accessories consisting of a bronze ball valve for inlet isolation, a 1-inch ball valve for draining and a ½-inch ball valve for flushing, quick connect couplings and a minimum of 5 feet of rubber hose.

2.02 VALVE BOXES

- A. All gate, butterfly and plug valves shall be provided with extension shafts, operating nuts and valve boxes as follows:
 - 1. Extension shafts shall be Type 304 stainless steel and the operating nut shall be 2-inch square. Shafts shall be designed to provide a factor of safety of not less than four. Operating nuts shall be pinned to the shafts.

2. Top of the operating nut shall be located 2-inch below the rim of the valve box.
3. Valve boxes shall be as manufactured by Clow; Mueller; Tyler; or equal and shall be a heavy-pattern cast iron, three-piece, telescoping type box with dome base suitable for installation on the buried valves. Inside diameter shall be at least 4 ½ inches. Barrel length shall be adapted to the depth of cover, with a lap of at least 6-inches when in the most extended position. Covers shall be cast iron with integrally-cast direction-to-open arrow, and the word "SEWER" shall also be integrally cast. Aluminum or plastic are not acceptable. A means of lateral support for the valve extension shafts shall be provided in the top portion of the valve box.
4. The upper section of each box shall have a top flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve and shall be oval.
5. An approved operating key or wrench shall be furnished.
6. All fasteners shall be Type 316 stainless steel.

2.03 METAL-SEATED GATE VALVES

A. General

1. All gate valves shall conform to the requirements of AWWA C500, except as may be specifically modified herein.
2. Valves 3-inch and larger shall be iron body, bronze mounted.
3. Valves 2 ½-inch and smaller shall be all bronze construction.

B. Gate valves 3-inch and larger

1. Valves shall be double disc-type with 150 psig working pressure rating with a minimum non-shock rating of 200 psig.
2. Buried valves shall have non-rising stems, mechanical joint ends and 2-inch square operating nuts. Valves shall be furnished with O-ring seals.
3. Furnish valves and accessories as manufactured by one of the following:
 - a. American Darling
 - b. Or equal

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

- A. During installation of all valves and appurtenances, verify that all items are clean, free of defects in material and workmanship and function properly.
- B. All valves shall be closed and kept closed until otherwise directed by the ENGINEER.

3.02 INSTALLATION OF BURIED VALVES AND VALVE BOXES

- A. Buried valves shall be cleaned and manually operated before installation. Buried valves and valve boxes shall be set with the stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping pipe bedding material under the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade. The valve box shall be set so as not to transmit traffic loads to the valve.
- B. Before backfilling, all exposed portions of any bolts shall be coated with two (2) coats of bituminous paint.
- C. Install valve floor stand operators with stainless steel bolts.

3.03 INSTALLATION OF TAPPING SLEEVES AND VALVES

- A. The proper authority shall be contacted and their permission granted prior to tapping a "live" line. The required procedures and time table shall be followed exactly.
- B. Installation shall be made under pressure and flow shall be maintained. The diameters of the tap shall be not less than 1/4-inch less than the inside diameter of the branch line.
- C. The entire operation shall be conducted by workers experienced in the installation of tapping sleeves and valves. The tapping machine shall be furnished by the CONTRACTOR.
- D. Determine the location of the line to be tapped to confirm that the proposed location will be satisfactory and that no interference will be encountered such as joints or fittings. No tap or sleeve will be made closer than three (3) feet from a pipe joint.
- E. Tapping sleeve and valve with boxes shall be set squarely centered on the line to be tapped. Adequate support shall be provided under the sleeve and valve during the tapping operation. Thrust blocks or other permanent restraint acceptable to the ENGINEER shall be provided behind all tapping sleeves. Proper tamping of supporting pipe bedding material around and under the valve and sleeve is mandatory for buried installations.

- F. After completing the tap, the valve shall be flushed to ensure that the valve seat is clean. All proper regulatory procedures (including disinfection) shall be followed exactly.

3.04 FIELD TESTS AND ADJUSTMENTS

- A. Conduct a functional field test of each valve, including actuators and valve control equipment, in presence of ENGINEER to demonstrate that each part and all components together function correctly. All testing equipment required shall be furnished by the CONTRACTOR.

3.05 MANUFACTURER'S SERVICE

- A. Following installation of the valves, furnish the services of a qualified, factory-trained representative of the manufacturer of the respective valves, to check the installations before they are placed in operation, supervise initial operations and testing in the presence of the ENGINEER, instruct the plant personnel in care and maintenance of the equipment, and make all necessary field adjustments. A minimum of eight (8) hour days, which may not necessarily be consecutive, shall be provided for these services. In the event of trouble with the equipment, the representative of the respective manufacturer shall revisit the site as often as necessary until all troubles are corrected and the installation is entirely satisfactory.

END OF SECTION

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SECTION 02667

UTILITY RELOCATION

PART 1 - GENERAL

1.01 SEWER RELOCATION AND UTILITY REPAIR

- A. Supply all materials, equipment, and labor required to maintain continuous flow in existing sewers, handle existing wastewater flow, construct and maintain all temporary connections and bypasses, and construct the permanent relocation of the sanitary sewer lines as shown on the Drawings and as directed by the ENGINEER.
- B. Supply all materials, equipment, and labor required for plugging existing sewers, all work on existing and new manholes, including all work and materials required to remove existing manholes and connecting new pipes to new and existing manholes.
- D. Notify the ENGINEER immediately of any discrepancies in elevations of existing sewers and manholes between those shown on the Drawings and those established during construction in order that the ENGINEER can make the necessary modifications.

1.02 RELATED WORK

- A. Earthwork in Section 02200.
- B. Ductile Iron Pipe and Fittings.

1.03 SUBMITTALS

- A. Submit, in accordance with Section 01300, all procedures for maintaining flows. Submittals shall include the following:
 - 1. Four (4) copies of a detailed written plan of all methods of flow maintenance, in advance of flow interruption.

1.04 PROTECTION OF EXISTING UTILITIES

- A. Assume full responsibility for the protection of all utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, whether or not they are shown on the Drawings. CONTRACTOR is responsible for all damage done to such utilities.

1. Should damage of any kind occur to the existing pipelines, make repairs to the satisfaction of the ENGINEER as part of the work under this Item.
2. Emergency Pipe Breakage Provisions
 - a. In case damage occurs to the existing 8-inch water or sewer main, CONTRACTOR'S work shall include having onsite the necessary materials to replace the water or sewer main as acceptable to the ENGINEER. The materials include piping, couplings, dewatering equipment, and temporary bypass service equipment, as necessary.
- B. Carefully support and protect all such utilities from injury of any kind. Repair any damage resulting from the CONTRACTOR'S operations at CONTRACTOR'S expense.
- C. Assistance will be given the CONTRACTOR in determining the location of existing services. The CONTRACTOR shall bear full responsibility, however, for obtaining all locations of underground structures and utilities (including existing water services, drain lines, gas lines and sewers). Maintain service and pay all costs or charges resulting from damage thereto.
- D. OWNER will pay the cost of utility relocations that are authorized by the ENGINEER. Determination of authorized relocations will be based upon the following guidelines:
 1. The utility is in physical conflict with the Work.
 2. Relocation of utility that can only be relocated by the utility owner: OWNER will pay relocation cost directly to utility owner. Perform all other utility relocations at the price bid or as agreed by Change Order.
- E. Utilities that are not in physical conflict with the Work may be relocated if allowed by the utility owner. Include the cost for relocating utilities not in physical conflict with the Work in the prices for the Work.
- F. Notify utility owner(s) (both aboveground and underground facilities) prior to proceeding with trench excavation whenever such trenching operations are within 10-feet of any existing utility.
- G. Notify utility owner if utility is damaged by the CONTRACTOR'S operations. Repair damaged utility only with written authorization. Provide ENGINEER a copy of every written authorization.

- H. Use granular bedding material to rebed utilities exposed below mid-diameter. Extend granular bedding material to the limits of the excavation and a minimum of 2-feet beyond each side of the exposed utility.
- I. Coordinate the removal and replacement of traffic loops and signals, if required for the performance of the work, at no additional cost to the OWNER.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

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SECTION 02720

PRECAST CONCRETE MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.01 SCOPE

Furnish all labor, materials, and equipment required to install precast concrete manholes and structures, frames and covers, access hatches, manhole rungs, ladders, and appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Section 02200 – Earthwork.

1.03 SUBMITTALS

A. Shop drawings, product data, materials of construction, and details of installation shall be submitted in accordance with Section 01300. Submittals shall include the following:

1. Base sections, riser sections, eccentric and concentric conical top sections, and flat slab tops with notarized certificate indicating compliance with ASTM C478.
2. Pipe connections to manholes and vaults.
3. Manhole rungs or ladders, including method of installation and notarized certificate indicating pull-out resistance tested.
4. Manhole frame and cover with notarized certificate indicating compliance with ASTM A48, Class 30.
5. Method of repair for minor damage to precast concrete sections.

1.04 STANDARD REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM A48 – Standard Specification for Gray Iron Castings.
2. ASTM A615 – Standard specification for deformed and plain carbon-steel bars for concrete reinforcement.
3. ASTM C33 – Standard Specification for Concrete Aggregates.

4. ASTM C150 – Standard Specification for Hydrated Lime for Masonry Purposes.
 5. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes.
 6. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 7. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections.
 8. ASTM D4101 – Standard Specification for Propylene Injection and Extrusion Materials.
- B. American Concrete Institute (ACI)
1. ACI 318 – Building Code Requirements for Structural Concrete.
 2. ACI 350R – Design Considerations for Environmental Engineering Concrete Structures.
- C. American Association of State Highway and Transportation Officials (AASHTO)
1. Standard Specifications for Highway Bridges.
- D. Occupational Safety and Health Administration (OSHA)
- E. Where reference is made to one of the above standards, the revision in effect at the time of Bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All material shall be new and unused.
- B. Materials' quality, manufacturing process, and finished sections are subject to inspection and approval by ENGINEER or other OWNER representative. Inspection may be made at place of manufacture, at work site following delivery, or both.
- C. Materials shall be rejected for failure to meet any Specification requirement. Rejection may occur at place of manufacture, at work site, or following installation. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to OWNER.
- D. Repair minor damage to precast concrete sections by approved method, if repair is authorized by ENGINEER.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
- C. Provide lifting lugs or holes in each precast section for proper handling Precast Concrete Sections:

2.02 PRECAST CONCRETE MANHOLE AND VAULT SECTIONS

- A. Precast concrete base sections, riser sections, transition top sections, flat slab tops, and grade rings shall conform to ASTM C478 and meet the following requirements:
 - 1. Bottom slab thickness shall equal the riser wall thickness or flat slab top thickness, whichever is greater.
 - 2. Top section shall be a flat slab.
 - 3. Base, riser, and transition top sections shall have tongue-and-groove joints.
 - 4. Sections shall be cured by an approved method.
 - 5. Precast concrete sections shall be shipped after concrete has attained 3,000 psi compressive strength.
 - 6. Design precast concrete base, riser, transition top, flat slab top, and grade ring for a minimum H-20 loading plus earth load. Calculate earth load with a unit weight of 130 pcf.
 - 7. Mark date of manufacture, name, and trademark of manufacturer on the inside of each precast section.
 - 8. Construct and install precast concrete base as shown on the Drawings.

2.03 FRAMES AND COVER

- A. Frames and covers for manholes shall meet OWNER standard requirements and shall be of a good quality, strong, tough, even-grained cast iron, except as otherwise specified below. Casting shall be as manufactured by East Jordan Iron Works or equal. Sizes shall be as shown on the Drawings. Covers shall have the letters "SANITARY SEWER" embossed on top.
- B. The covers and frame are to be set flush with finished paving or 6 inches above grade in landscaped areas, unless otherwise specified.
- C. The installation and attachment of all vault hatchways shall be detailed on a shop drawing and submitted for approval. A steel insert frame shall be cast with the vault and the hatchway bolted to it, either pre- or post-casting.

2.04 JOINTING PRECAST MANHOLE SECTIONS

- A. Seal tongue and groove joints of precast manhole sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring gasket shall conform to ASTM C443. Preformed flexible joint sealant shall be Kent Seal No. 2 as manufactured by Hamilton-Kent, Ram-Nek as manufactured by K.T. Snyder Company, or equal.
- B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.05 RUNGS FOR MANHOLES AND STRUCTURES

- A. Rungs shall be either of the following types:
 - 1. Cast aluminum alloy 6061-T6, drop-front design, 12 inches wide, with an abrasive step surface conforming to OSHA requirements.
 - 2. Steel-reinforced, copolymer polypropylene, 14 inches wide, M.A. Industries Inc, PF Series or equal. Copolymer polypropylene shall conform to ASTM D4101 Classification PP200 B33450 Z02. Steel reinforcing shall be 2-inch diameter, conforming to ASTM A615, Grade 60, and shall be continuous throughout rung.

2.06 PIPE CONNECTIONS TO MANHOLE AND STRUCTRES

- A. Connect pipe to manhole in the following ways:
 - 1. Grout in Place — Precast manhole and vault sections shall have a formed, tapered, circular opening larger than the pipe outside diameter. Grout shall be nonshrink and waterproof equal to Hallemite, Waterplug, or Embecco.

2.07 DAMPPROOFING

- A. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products, Dehydratine 4 by A.C. Horn Inc., RIW Marine Liquid by Toch Brothers, or equal.

2.08 VAULTS

- A. Vaults are precast concrete structures, square or rectangular in shape, usually with a precast structural invert and top slab. Unless otherwise detailed on the drawings and/or specified, they shall have a minimum 6-foot, 6-inch inside height; a 3-foot, 6-inch x 3-foot, 6-inch hatch opening; access rungs are specified; and H-20 highway load rating on the cover slab.

2.09 PRECAST CONCRETE STRUCTURES

- A. Precast reinforced concrete structures shall be as manufactured by Oldcastle Precast, Tindall, or equal. Refer to Drawings for interior dimensions and minimum thickness of concrete.
- B. Manufacturer shall notify ENGINEER at least five (5) working days prior to placing concrete during the manufacturing process. ENGINEER may inspect reinforcing steel placement prior to placing concrete.
- C. Structural design calculations and drawings shall be prepared and stamped by a professional engineer registered in Georgia.
- D. Design Criteria
 - 1. Precast Concrete
 - a. Minimum compressive strength shall be 5,000 psi at 28 days.
 - b. Maximum water content shall be 6 gallons per 94-pound sack of cement.
 - c. Minimum cement content shall be six (6) 94-pound sacks of cement per cubic yard of concrete.
 - 2. Manufactured Products
 - a. Shall conform to ACI 318 and ACI 350R.
 - b. Analyze walls and slabs using accepted engineering principles.
 - c. When “fy” exceeds 40,000 psi, “z” (ACI 318) shall not exceed 95,000 psi; “fs” shall not exceed 50 percent of “fy”.

- d. Design products to support their own weight, weight of soil at 120 pcf, and a live load equal to AASHTO HS-20 applied to top slab.
- e. Cast base slab and walls together to form a monolithic base section.
- f. Design structure walls for a water pressure of 90 psf. Originate pressure diagram at finished ground surface. Include lateral pressure from vehicles in accordance with AASHTO.
- g. Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.
- h. Prevent flotation, with ground water level at finished ground water surface, by dead weight or structure and soil load above structure. Do not consider skin friction, soil friction, or weight of equipment in structure.
- i. Locate horizontal wall joints 18 inches, minimum, from horizontal centerline of wall openings.
- j. Design structure with a minimum number of joints. Maximum number of structure sections, including top slab, shall be four (4).
- k. Provide lifting hooks for top slabs.
1. Locate access openings and pipe penetrations as shown on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Manholes and structures shall be constructed to the dimensions shown on the Drawings and as specified in these Specifications. Protect all work against flooding and flotation.
2. Place structure or manhole base on a bed of 12-inch, minimum, screened gravel or as shown on the Drawings. Set manhole base grade so that a maximum grade adjustment of 8 inches is required to bring the manhole frame and cover to final grade.

- a. Where shown on the Drawings, use precast concrete grade rings or brick and nonshrink mortar to adjust manhole frame and cover to final grade.
3. Set precast concrete barrel sections plumb with a 1/4-inch-maximum out-of-plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring, set in a recess, or preformed flexible joint sealant in sufficient quantity to fill 75 percent (75%) of the joint cavity. Fill the outside and inside joint with nonshrink mortar and finish flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or nonshrink grout to the satisfaction of the ENGINEER.
4. Allow joints to set for 14 hours before backfilling, unless a shorter period is specifically approved by the ENGINEER.
5. Plug holes in the concrete barrel sections required for handling with a nonshrinking grout or nonshrinking grout in combination with concrete plugs. Finish flush on the inside.
6. Cut holes in precast sections to accommodate pipes prior to setting manhole and vault sections in place to prevent jarring which may loosen the mortar joints.
7. Backfill carefully and evenly around manhole sections and structures.

B. Rung Installation

1. Aluminum Rungs
 - a. Grout aluminum rungs into precast sections on 12-inch centers. Preform holes in riser and cone sections for rungs during casting. Holes for rungs shall be 1-1/8 inches in diameter and a minimum of 3 1/2 inches deep.
 - b. Grout rungs into precast sections immediately after casting and placing in the curing area, or immediately after coring holes for rungs into base section. Fill holes with grout consisting of Portland Type II cement and mortar sand in a 1 to 2 ratio mixed to a putty consistency.
 - c. Paint those parts of the rungs that are embedded with a heavy coating of zinc chromate or other approved paint.
2. Steel Reinforced Polypropylene Plastic Manhole Rungs
 - a. Preform holes for manhole rungs during casting of the riser and cone sections, using tapered form pins specifically made for preforming manhole rung holes.

- b. Drive manhole rungs into preformed holes after concrete has developed a compressive strength of 3,000 psi.
- c. Alternatively, cast manhole rungs into riser and cone sections when concrete is placed.
- d. Drilling holes for manhole rungs may be used to accommodate field conditions when approved by the ENGINEER. Drill holes of diameter, spacing, and depth required by manhole rung manufacturer.

3. Pull-out Resistance Test

- a. All manhole rung installation methods shall withstand a pull-out resistance test of 1,500 pounds.

C. Setting Manhole Frame and Cover

- 1. Set manhole covers and frames in a full mortar bed. Utilize precast concrete grade rings, a maximum of 8 inches thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

D. Dampproofing

- 1. Paint outer surfaces of manholes and structures with two coats of bituminous dampproofing at the rate of 30 to 60 ft² per gallon, in accordance with manufacturer's instructions.

3.02 LEAKAGE TESTS

A. Test each manhole for leakage. ENGINEER shall observe each test. Perform exfiltration test as described below:

- 1. Assemble manhole in place. Fill and point all lifting holes and exterior joints within 6 feet of the ground surface with an approved nonshrinking mortar. Test before filling and pointing the horizontal joints below 6 feet of depth. Lower ground water table below bottom of the manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blow out.

2. Fill manhole with water to the top of the cone section. If the excavation has not been backfilled and no water is observed moving down the surface of the manhole, the manhole is satisfactorily watertight. If the test, as described above is unsatisfactory as determined by the ENGINEER, or if the manhole excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill manhole to the top of the cone, if necessary, and allow at least 8 hours to pass. At the end of the test period, refill the manhole to the top of the cone again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole shall not exceed 1 gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed 3 gallons per vertical foot per day, repairs by approved methods may be made as directed by the ENGINEER. If leakage due to a defective section of joint exceeds 3 gallons per vertical foot per day, the manhole shall be rejected. Uncover the rejected manhole as necessary and disassemble, reconstruct or replace it as directed by the ENGINEER. Retest the manhole and, if satisfactory, fill and paint the interior joints.
 3. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.
- B. An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the manhole. If there is no leakage into the manhole as determined by the ENGINEER, the manhole will be considered watertight. If the ENGINEER is not satisfied, testing shall be performed as described hereinbefore.

3.03 CLEANING

- A. Thoroughly clean all manholes and structures of all silt, debris, and foreign matter of any kind prior to final inspections.

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SECTION 02905

LANDSCAPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following:

1. Trees.
2. Shrubs.
3. Plants.
4. Ground cover.
5. Permanent Managed Vegetation.
6. Soil amendments.
7. Initial maintenance of landscape materials.

B. Work Includes: Landscaping shall include all new landscaping as shown on Drawings, and repair of areas disturbed by construction work around new or existing structures or piping.

1.02 SUBMITTALS

A. Shop Drawings: Submit in accordance with Section 01330, Shop Drawings covering the items included under this Section. Shop Drawing submittals shall include:

1. Plant and Material Certifications:
 - a. Certificates of inspection as required by government authorities.
 - b. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
 - c. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
 - d. Seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentages by weight, and percentages of purity, germination, and weed seed for each grass seed species.
 - e. Material test reports for existing surface soil and imported topsoil.
2. Samples: Supply ENGINEER with the following samples for approval before installation:
 - a. Mulch.
 - b. Sod.

3. Planting Schedule: Proposed planting Schedule, indicating dates for each type of landscape work during normal seasons for such work in area of Site. Correlate with specified maintenance periods to provide maintenance from date of Substantial Completion. Once accepted, revise dates only as approved in writing after documentation of reasons for delay.
4. Maintenance Instructions: Typewritten instructions recommending procedures to be established by OWNER for maintenance of landscape work for 1 full year. Submit prior to expiration of required maintenance period(s).

1.03 QUALITY ASSURANCE

- A. Qualifications: Employ a single firm specializing in landscape work, whose work has been in satisfactory use for not less than 5 years.
- B. Soil Testing Laboratory Qualifications: An independent laboratory recognized by the State Department of Agriculture, with the experience and capability to conduct testing indicated, and specializes in types of tests performed.
- C. Source Quality Control:
 1. Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
 2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to ENGINEER, together with proposal for use of equivalent material.
 3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
 4. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - a. Report suitability of topsoil for plant growth. State recommended quantities of nitrogen, phosphorous, and potash nutrients and soil amendments to be added to produce a satisfactory topsoil.
 5. Trees, Shrubs, and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1, "American Standard for Nursery Stock." Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree and shrub for height and spread; do not measure branches or roots tip-to-tip.
 6. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

- a. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
7. Pre-inspection: All trees required by this Contract shall be tagged by CONTRACTOR, at the source, for inspection and approval by ENGINEER in writing at least 2 weeks prior to each desired inspection date. Photographs of materials may be required for preliminary inspection of materials from remote sources.
8. Inspection: ENGINEER may inspect trees and shrubs either at place of growth or at Site before planting, for compliance with requirements for genus, species, variety, size, and quality. ENGINEER retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries, and latent defects, and to reject unsatisfactory or defective material at any time during progress of Work. Remove rejected trees or shrubs immediately from Project Site.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at Site.
- B. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.
- C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by ENGINEER. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
 1. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
 2. Do not remove container-grown stock from containers until planting time.

1.05 PROJECT CONDITIONS

- A. Utilities: Determine location of underground utilities and perform Work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify ENGINEER before planting.

1.06 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete landscape Work as rapidly as portions of Site become available, working within seasonal limitations for each kind of landscape Work required.
 - 1. Plant or install materials during normal planting seasons for each type of plant material required.
 - 2. Correlate planting with specified maintenance periods to provide maintenance from date of Substantial Completion.
- B. Coordination with Permanent Managed Vegetation (PMV) Areas: Plant trees and shrubs after final grades are established and prior to planting of PMV areas, unless otherwise acceptable to ENGINEER. If planting of trees and shrubs occurs after PMV area work, protect PMV areas and promptly repair damage to area resulting from planting operations.

1.07 SPECIAL PROJECT WARRANTY

- A. Warranty PMV areas through specified PMV areas maintenance period and until final acceptance.
- B. Warranty trees and shrubs through specified maintenance period and until final acceptance.
 - 1. Warranty trees and shrubs for a period of 1 year after date of Substantial Completion against defects including death and unsatisfactory growth, except for defects resulting from neglect by OWNER, abuse or damage by others, or unusual phenomena or incidents which are beyond landscape Installer's control.
 - a. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace trees and shrubs which are in doubtful condition at end of warranty period; unless, in opinion of ENGINEER, it is advisable to extend warranty period for a full growing season.
 - b. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub, or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with specified requirements, manufacturers offering products which may be incorporated in Work include:

2.02 TOPSOIL

- A. Topsoil has been (or will be) stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape Work.
- B. Provide new topsoil that complies with ASTM D 5268, having a pH of 5 to 7, an organic matter content of 2 to 20 percent, a sand content of 20 to 60 percent, and a silt and clay content of 35 to 70 percent. Deleterious materials such as rock, gravel, slag, cinders, roots, and sod may not exceed 5 percent. Provide topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds, and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.
 - 1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at Project Site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.03 SOIL AMENDMENTS

- A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
- B. Aluminum Sulfate: Commercial grade.
- C. Peat Humus: Peat shall be granulated raw Canadian peat or baled Canadian peat, containing not more than 9 percent mineral on a dry basis. For ericaceous plants, baled peat with a pH of 4.0 shall be used.
- D. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
- E. Superphosphate: Soluble mixture of treated minerals; 40 percent available phosphoric acid.
- F. Sand: Clean, washed sand, free of toxic materials.
- G. Perlite: Conforming to National Bureau of Standards PS 23.
- H. Vermiculite: Horticultural grade, free of toxic substances.
- I. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil, or toxic substances and with 7.5 pounds of nitrogen uniformly mixed into each cubic yard of sawdust.

- J. Manure: Well rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants.
- K. Mulch: Shredded bark mulch free from deleterious materials and suitable for top dressing of trees, shrubs, or plants.
- L. Weed Killers: A pre-emergent weed killer such as "Banlon," or approved equal, shall be used on all mulched areas as directed by manufacturer.
- M. Commercial Fertilizer: Complete fertilizer of neutral character with some elements derived from organic sources and containing following percentages of available plant nutrients:
 - 1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid, and 5 percent soluble potash.
 - 2. For PMV areas, provide fertilizer with percentage of nitrogen required to provide not less than 1 pound of actual nitrogen per 1,000 square foot of PMV area and not less than 4 percent phosphoric acid and 2 percent potassium. Provide nitrogen in a form that will be available to PMV areas during initial period of growth; at least 50 percent of nitrogen to be organic form.

2.04 PLANT MATERIALS

- A. Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape Work and complying with recommendations and requirements of ANSI Z60.1, "American Standard for Nursery Stock."
- B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
 - 1. Provide balled and burlapped (B&B) deciduous trees.
- C. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
 - 1. Provide balled and burlapped (B&B) deciduous shrubs.
 - 2. Container grown small deciduous shrubs will be acceptable in lieu of balled and burlapped (B&B) deciduous shrubs subject to specified limitations for container grown stock.

2.05 GRASS MATERIALS

- A. Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed mixture composed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified on plans.
- B. Sod: Provide strongly rooted sod, not less than 2 years old, free of weeds and undesirable native grasses, and machine cut to pad thickness of 3/4 inch (plus or minus 1/4 inch), excluding top growth and thatch. Provide only sod capable of vigorous growth and development when planted (viable, not dormant). Peat sod will not be acceptable.
 - 1. Provide sod of uniform pad sizes with maximum 5 percent deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10 percent of pad will be rejected.
 - 2. Provide sod composed principally of following:
 - a. Mixed Kentucky Bluegrass (*Poa pratensis*).

2.06 GROUND COVER

- A. Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for pot size shown or listed.

2.07 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Seeding Mulch: Provide clean, seed-free straw or excelsior mulch.
 - 1. Straw Mulch: Threshold straw, oats, spring wheat, spring barley, or spring rye, not chopped in short lengths and containing no noxious weeds.
 - 2. Fiber Mulch: Biodegradable, dyed-wood cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Asphalt Emulsion: ASTM D 977, Grade SS-1, non-toxic and free of plant growth or germination inhibitors.
- C. Anti-Desiccant: Emulsion type, film-forming agent designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.

- D. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood, or redwood, free of knotholes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire, not lighter than 12-gauge with zinc-coated turnbuckles. Provide not less than 1/2-inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.
 - 1. Stakes for guying shall be wood, 2-inch by 2-inch by 30-inch long, minimum size.
 - 2. Stakes for trees shall be sound, 4-inch diameter, 9-foot long, cedar posts with bark skinned off for shade trees; 2-inch by 2-inch, 8-foot long for conifers under 5-foot height.
- E. Wooden Pegs (SOD): Provide wooden pegs 1-inch by 1-inch or 1-inch by 2-inch, 10-inch minimum length.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding overspray.
- B. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil-bearing runoff or airborne dust to adjacent properties and sidewalks.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure ENGINEER's acceptance before start of planting work. Make minor adjustments as may be required. CONTRACTOR should schedule CONTRACTOR'S work and arrange to stake enough planting work for 2 weeks and arrange for a periodic Site meeting with ENGINEER for the purpose of reviewing work that has taken place in the prior 2 weeks and approval of the staking for the next 2 weeks.
- D. It is understood and agreed that should minor changes and deviations from Drawings or staking be required by ENGINEER, this shall be done by CONTRACTOR at no additional cost, providing such instructions are given to CONTRACTOR before such affected work other than staking is started.
- E. CONTRACTOR shall accurately stake layout of plant material according to Drawings. Stakes shall be 3 feet high above grade and painted a bright color to be clearly visible for inspection. Distinguish by color between types of materials, i.e., evergreen trees, canopy trees, shrubs, flowering trees.

3.02 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days. Schedule of Planting Soil Mixture Requirements is attached at end of this Section.
- C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at Site.

3.03 PREPARATION FOR PLANTING PERMANENTLY MANAGED VEGETATION (PMV) AREAS

- A. Loosen subgrade of PMV areas to a minimum depth of 4 inches. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
 - 1. CONTRACTOR shall request and receive written approval of subgrade from ENGINEER prior to spreading topsoil.
 - 2. Spread topsoil to provide a minimum depth of 6 inches as required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
 - 3. Place approximately 1/2 of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
- B. Preparation of Unchanged Grades: Where PMV areas are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for PMV area planting as follows. Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
 - 1. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of OWNER's property. Do not turn existing vegetation over into soil being prepared for PMV areas.
 - 2. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if PMV area planting will not follow within a few days.

- a. Schedule of Planting Soil Mixture Requirements, indicating required rate of fertilizer application, is attached at end of this Section.
- C. Fine grade PMV areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag PMV areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
- D. Moisten prepared PMV areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting PMV area. Do not create a muddy soil condition.
- E. Restore PMV areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.04 EXCAVATION FOR TREES AND SHRUBS

- A. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - 1. For balled and burlapped (B&B) trees and shrubs, make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:
 - a. Allow for 6-inch thick setting layer of planting soil mixture.
 - 2. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
- B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
- C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

3.05 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Set container grown stock, as specified, for B&B stock, except cut cans on two sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.

- C. Dish top of backfill to allow for mulching.
- D. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.
 - 1. Provide 3-inch thickness of mulch.
- E. Apply anti-desiccant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage.
 - 1. If deciduous trees or shrubs are moved when in full leaf, spray with anti-desiccant at nursery before moving and spray again 2 weeks after planting.
- F. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by ENGINEER, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- G. Remove and replace excessively pruned or mis-formed stock resulting from improper pruning.
- H. Wrap tree trunks of 2 inches caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures before wrapping.
- I. Guy and stake trees immediately after planting, as indicated.

3.06 SEEDING NEW PERMANENTLY MANAGED VEGETATION (PMV) AREAS

- A. Mulch shall be spread evenly with extreme care so as to leave the seeded surface with a minimum amount of damage. Use straw or excelsior mulch.
- B. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- C. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.
- D. Sow not less than the quantity of seed specified or scheduled.
- E. Rake seed lightly into top 1/8-inch of soil, roll lightly, and water with a fine spray.
- F. Protect seeded areas against erosion by spreading mulch within 24 hours after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2 inches loose measurement over seeded areas.

1. Straw mulch shall be applied uniformly at a rate of approximately 2 tons per acre on seeded areas. The mulch shall be loose enough to permit air to circulate but compact enough to reduce erosion.
 2. Anchor mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1,000 square feet. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas.
- G. Maintenance and Acceptance: It is the responsibility of CONTRACTOR to establish a dense stand of permanent grasses, free from lumps and depressions. Any part of the area that fails to show a uniform germination shall be reseeded, and such reseeding shall continue until a dense stand is established. Damage to seeded areas resulting from erosion shall be repaired by CONTRACTOR. Scattered bare spots will not be allowed over 3 percent of the area.

3.07 HYDROSEEDING NEW PERMANENTLY MANAGED VEGETATION (PMV) AREAS

- A. Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
- B. Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified seed sowing rate.
 1. Mix slurry with non-asphaltic tackifier.
 2. Apply slurry to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 1,500 pounds per acre dry weight, but not less than the rate required to obtain specified seed-sowing rate.

3.08 SODDING NEW PMV AREAS

- A. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
- C. When sod is laid on slopes, the first row of sod shall be laid at the bottom of the slope parallel to it, with subsequent rows laid from bottom to top. On slopes steeper than 3:1, the sod shall be secured with pegs spaced at 2 feet maximum, vertically and horizontally.
- D. Water sod thoroughly with a fine spray immediately after planting.

- E. Sodded areas shall be kept moist for the maintenance period. After sod is installed, all areas greater than 1 foot which fail to show a uniform stand of grass shall be resodded.

3.10 RECONDITIONING EXISTING PMV AREAS

- A. Recondition existing PMV areas damaged by CONTRACTOR's operations including storage of materials and equipment and movement of vehicles. Also recondition existing PMV areas where minor regrading is required.
- B. Provide fertilizer, seed or sod, and soil amendments as specified for new PMV areas, and as required, to provide a satisfactorily reconditioned PMV area.
- C. Provide new topsoil, as required, to fill low spots and meet new finish grades.
- D. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
- E. Remove diseased and unsatisfactory PMV areas; do not bury into soil. Remove topsoil containing foreign materials resulting from CONTRACTOR's operations, including oil drippings, stone, gravel, and other loose building materials.
- F. Where substantial PMV area remains but is thin, mow, rake, aerate if compacted, fill low spots, remove humps, and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- G. Water newly planted PMV areas and keep moist until new grass is established.

3.11 PLANTING GROUND COVER

- A. Space ground cover plants as indicated or scheduled.
- B. Space ground cover plants not more than 24 inches o.c.
- C. Dig holes large enough to allow for spreading of roots and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover crowns of plants with wet soils.
- D. Mulch areas between groundcover plants; place not less than 2 inches thick.

3.12 MAINTENANCE

- A. Begin maintenance immediately after planting.

- B. Maintain trees, shrubs, and other plants until final acceptance, but in no case, less than following period:
1. One year after Substantial Completion of planting.
- C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.
1. Watering: Water trees and shrubs and ground cover at least twice each month from May 15 to September 25th, or as directed by OWNER.
 2. Weeding: Keep planting beds and tree saucers free from weeds to the satisfaction of OWNER. Note that treatment of mulch with pre-emergent weed killer is required in the Specification.
 3. Spraying: Spraying shall encompass dormant oil with ethion for scale insects, malathion for leaf-eating insects, and bordeaux mixture for fireblight control. These shall be applied in accordance with the manufacturer's recommendations and in the proper strength and number of applications for the particular insect or disease. Provide OWNER and ENGINEER a written record of applications and dates.
 4. Refertilization: Refertilization shall be per GADOT Specifications. Provide fertilizer in first and second waterings of the second growing season with a nitrogen-enriched solution providing 8.3 pounds available per 1,000 gallons water. Provide OWNER and ENGINEER a written record of applications and dates.
 5. Adjustments: Keep trees erect. Raise trees that settle below grade to the established elevation. Keep tree wrap in neat condition. Remove at completion of guarantee period.
 6. Grade Adjustment: Fill to the original grade level areas that have settled around trees and shrubs.
 7. ENGINEER shall be notified at least 2 workdays prior to each maintenance trip. Written notification of what maintenance was performed must be sent to ENGINEER within 2 days after each maintenance trip.
- D. Maintain PMV area for not less than the period stated below, and longer as required to establish an acceptable PMV area.
1. Seeded PMV areas, not less than 60 days after Substantial Completion.

2. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable PMV area is established.
 3. Sodded PMV areas, not less than 30 days after Substantial Completion.
- E. Maintain PMV areas by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable PMV area, free of eroded or bare areas.

3.13 CLEAN UP AND PROTECTION

- A. During landscape Work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape Work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.14 INSPECTION AND ACCEPTANCE

- A. When landscape Work is completed, including maintenance, ENGINEER will, upon request, make an inspection to determine acceptability.
 1. Landscape Work may be inspected for acceptance in portions as agreeable to ENGINEER, provided each portion of Work offered for inspection is complete, including maintenance.
- B. When inspected landscape Work does not comply with requirements, replace rejected Work and continue specified maintenance until reinspected by ENGINEER and found to be acceptable. Remove rejected plants and materials promptly from Project Site.

END OF SECTION

SECTION 02910

BIORETENTION MEDIA PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Description: Bioretention facilities are small landscaped basins intended to provide stormwater management by collecting and filtering stormwater runoff before percolating in to the ground or discharging to drainage systems. This work shall consist of installing bioretention facilities as specified in the Contract Documents, including all materials, equipment, labor and services required to perform the work.

B. Related Requirements: Review the General Contract Conditions and, General Requirements, which contain information and requirements that apply to this Section.

C. Work Included:

Provide and install media amendments in all proposed areas to receive plant bioretention soil.

Provide testing and certification of existing and import soils.

Finish grading.

Transporting and storage of soils and planting mediums.

D. Related Work in Other Sections:

1. Section 02900 – Landscaping

E. Substitutions: Substitute products will be considered only under the terms and conditions of Section 01630.

1.2 SUBMITTALS

A. Samples and Product Data: Prior to delivery to site, submit samples, certification and manufacturers' literature for the following items:

1. Chemical Additives: mfg. literature and delivery slips.

2. Delivery Slips/Purchase Orders: Three (3) copies of each delivery slip/purchase order for all amendments.

- B. Submittal Schedule: At least 45 days prior to the start of construction of bioretention facilities, the Contractor shall submit the source of the Planting Soil for the BSM to the Engineer for approval. No time extensions will be granted should the proposed Planting Soil fail to meet the minimum requirements stated above. Once a stockpile of the Planting Soil has been sampled, no material shall be added to the stockpile.

1.3 QUALITY ASSURANCE

- A. Certificates of inspection: Provide those required by law for transportation, with invoice. File copies of certificates with ENGINEER after acceptance of material. Inspection by governmental officials at point of origin does not preclude rejection of materials at project site.
- B. Intent: The amendments and quantities included herein are approximate and are for bidding purposes only. Following an on-site soil analysis by the Project Agronomist, composition of amendments may change. Contract price shall be adjusted accordingly.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Labeling: Furnish standard products in unopened manufacturer's standard containers bearing original labels showing quantity, analysis and name of manufacturer.
- B. Storage: Store products with protection from weather or other conditions which would damage or impair the effectiveness of the product.

1.5 ANALYSES OF SAMPLES AND TESTS

- A. Sampling: ENGINEER reserves the right to take and analyze samples of materials for conformity to specifications at any time. Furnish samples upon request by ENGINEER.
- B. Rejected Materials: Remove rejected materials immediately from the site at Contractor's expense.
- C. Testing: Pay cost of testing of materials not meeting specifications.

1.6 FINAL ACCEPTANCE

- A. Acceptance: Work will be accepted by the ENGINEER upon satisfactory completion of all soil preparation work.
- B. Notification: Notify ENGINEER for review of soil preparation prior to proceeding with planting operations.

PART 2 - PRODUCTS

MATERIAL	SPECIFICATION
No. 57 Aggregate	ASTM 633
Plant Materials	See below.
Water	See below.
Limestone	ASTM C25
Iron Sulfate	See below.
Magnesium Sulfate	See below.
Potash	See below.

Bioretention Soil Mixture: The Bioretention Soil Mixture (BSM) is a soil or soil mixture which meets specific texture, and composition criteria. The USDA textural classification of the BSM shall be LOAMY SAND OR SANDY LOAM. The BSM shall be salvaged or furnished. Additionally, the BSM shall be tested and meet the following criteria:

ITEM	PERCENT BY WEIGHT	TEST METHOD
Sand (2.0 – 0.050 mm)	85-90%	AASHTO T88
Silt (0.050 – 0.002 mm)	<10%	AASHTO T88
Clay (less than 0.002 mm)	<5%	AASHTO T88
Organic Matter	1.5 – 2%	AASHTO T194

The textural analysis for the planting Soil shall be as follows:

ASTM E11 SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
2 in.	100
No. 4	90
No. 10	80

The Bioretention Soil Mixture (BSM) shall be a uniform mix, free of stones, stumps, roots or other similar objects larger than two inches excluding mulch. No other materials or substances shall be mixed or dumped within the bioretention area that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.

The Bioretention Soil Mixture shall be tested and meet the following criteria:

Item	Criteria	Test Method
Corrected pH	5.5 – 7.5	ASTM D4972
Magnesium	Minimum 32 ppm	*
Phosphorus (Phosphate - P ₂ O ₅)	Not to exceed 69 ppm	*
Potassium (K ₂ O)	Minimum 78 ppm	*
Soluble Salts	Not to exceed 500 ppm	*

* Use authorized soil test procedures.

Should the pH fall outside of the acceptable range, it may be modified with lime (to raise) or iron sulfate plus sulfur (to lower). The lime or iron sulfate must be mixed uniformly into the BSM prior to use in bioretention facilities.

Should the BSM not meet the minimum requirement for magnesium, it may be modified with magnesium sulfate. Likewise, should the BSM not meet the minimum requirement for potassium, it may be modified with potash. Magnesium sulfate and potash must be mixed uniformly into the BSM prior to use in bioretention facilities.

Planting soil and/or BSM that fails to meet the minimum requirements shall be replaced at no additional cost to the Administration. Mixing of the corrective additives to the BSM is incidental and shall be at no additional cost to the Administration.

Mixing of the BSM to a homogeneous consistency shall be done to the satisfaction of the Engineer.

Limestone. Limestone shall contain not less than 85 percent calcium and magnesium carbonates. Dolomitic (magnesium) limestone shall contain at least 10 percent magnesium as magnesium oxide and 85 percent calcium and magnesium carbonates.

Limestone shall conform to the following gradation:

SIEVE SIZE	MINIMUM PERCENT PASSING BY WEIGHT
No. 10	100
No. 20	98
No. 100	50

Iron Sulfate. Iron sulfate shall be a constituent of an approved horticultural product produced as a fertilizer for supplying iron and as a soil acidifier.

Magnesium Sulfate. Magnesium sulfate shall be a constituent of an approved horticultural product produced as a fertilizer.

Potash. Potash (potassium oxide) shall be a constituent of an approved horticultural product produced as a fertilizer.

Excavation. If the soil is classified as a clay soil (USDA textural classification), the roto-tilling shall not be done where the soil supports the aggregate bed underneath the underdrain. (See underdrain specifications below.) Clay soils beyond the edge of the aggregate bed shall be first overlain with a BSM layer 3 inches thick, and then roto-tilled to a depth 6 inches below the surface of the BSM layer.

Mulch. Shall be free of sand, soil, debris and deleterious materials as certified by the supplier. Mulch shall consist of shredded hardwood which knits in a manner to minimize sloughing, floating or being kicked away. The mulch shall be stockpiled or stored for a minimum of 12 months.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Description: Bioretention facilities shall not be constructed until all contributing drainage areas are stabilized as shown on the Contract Plans and to the satisfaction of the Engineer. Bioretention facilities shall not be used as sediment control facilities. No heavy equipment shall operate within the perimeter of a bioretention facility during excavation, underdrain placement, backfilling, planting, or mulching of the facility.
- B. Excavation: The bioretention facility shall be excavated to the dimensions, side slopes, and elevations shown on the Contract Plans. The method of excavation shall minimize the compaction of the bottom of the bioretention facility. Excavators and backhoes, operating on the ground adjacent to the bioretention facility, shall be used to excavate the facility if possible. Low ground-contact pressure equipment may also be used for

excavation. No heavy equipment shall be allowed on the bottom of the bioretention facility. Excavated materials shall be used or disposed of in conformance with Section 201. Prior to placing the underdrain and the BSM, the bottom of the excavation shall be roto-tilled to a minimum depth of 6 inches to alleviate any compaction of the facility bottom. Any substitute method for roto-tilling must be approved by the Engineer prior to use. Any ponded water shall be removed from the bottom of the facility and the soil shall be friable before roto-tilling.

- C. Placement and Compaction of the Bioretention Soil Mixture: The Bioretention Soil Mixture (BSM) shall be placed and graded using low ground-contact pressure equipment or by excavators and/or backhoes operating on the ground adjacent to the bioretention facility. No heavy equipment shall be used within the perimeter of the bioretention facility before, during, or after the placement of the BSM. The BSM shall be placed in horizontal layers not to exceed 12 inches for the entire area of the bioretention facility. The BSM shall be compacted by saturating the entire area of the bioretention facility after each lift of BSM is placed until water flows from the underdrain. Water for saturation shall be applied by spraying or sprinkling. Saturation of each lift shall be performed in the presence of the Engineer. An appropriate sediment control device shall be used to treat any sediment-laden water discharged from the underdrain. If the BSM becomes contaminated during the construction of the facility, the contaminated material shall be removed and replaced with uncontaminated material at no additional cost to the Administration. Final grading of the BSM shall be performed after a 24-hour settling period. Final elevations shall be within 2 inches of elevations shown on the Contract Plans.
- D. Mulching: Once the plants are in place, the entire bioretention facility shall be mulched to a uniform thickness of 3 inches. Well aged (minimum age of 6 months) shredded hardwood bark mulch is the only acceptable mulch.

END OF SECTION

SECTION 02950

IN-STREAM STRUCTURES

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

- A. This specification covers all items related to in-stream structures as specified on the plans or as directed by the Owner's Representative.
- B. The Work covered by this specification consists of furnishing all materials, equipment, and labor for the construction of in-stream structures at the locations and to the extents indicated on the Drawings

PART 2 - PRODUCTS

2.01 LOCATIONS

- A. Products specified in this Section shall be placed only in the locations indicated on the contract drawings, except where noted.

2.02 MATERIALS

A. Boulders

Boulders are to be solid granite rock quarried locally with a specific gravity of at least 2.6. Boulders should be generally resistant to erosion and should not degrade due to normal stream chemistry.

Footing boulders shall measure at least 9in x 12in x 12in. Each footing boulder shall have weight greater than 122 lb. Existing bedrock, if available, may be used in lieu of footing boulders where site conditions permit, if accepted by the Engineer.

Surface boulders shall measure at least 9in x 12in x 18in. Surface boulders shall have weight greater than 183 lb.

All boulders shall have an intermediate diameter of no less than 12 inches, where the intermediate diameter is established as neither the largest or smallest dimension of the three mutually perpendicular sides. Boulders with larger dimensions will be accepted. All boulders placed within the active channel must be placed on a footing boulder. Rectangular boulders are preferred over angular boulders as flat surfaces are best for construction of in-stream structures.

B. Structure logs

Structure logs are intended to be constructed from trees designated for removal on-site. Structure logs shall be free of disease, rot and insects. If the Engineer determines that on-site trees are not acceptable, hardwood logs may be brought in from off-site. Logs shall have a minimum diameter of 12 inches as measured at breast height of the original tree. The length of the structure log should correspond to the length designated on the drawings, at minimum.

C. Bedding material

Bed material aggregates shall be gravel or crushed stone. Aggregates may be crushed granite or other material approved by the Engineer as locally available. Aggregates from crushed granite shall be thoroughly washed and screened to remove dust, fines, and soil particles. Stream bed material shall be placed with a typical thickness of 18 inches in riffle sections with a surface tolerance of 3 inches of finished grade. Recycled river bed material may be stockpiled during excavation and mixed into the new bed material or used as a top dressing to the completed restoration channel bed.

D. Non-woven geotextile filter fabric

Filter fabric shall consist of a non-woven geotextile fabric with equivalent properties of Class 2 fabric as outlined in Technical Supplement 14D – Geosynthetics in Stream Restoration as part of the National Engineering Handbook Part 654.

E. Coir matting

Coir erosion control fabrics shall consist of 100% biodegradable, natural coir drawn from coconut husks with an open weave construction. Fabric used for slope protection shall have a minimum weight of 400 grams per square meter as specified in ASTM D3776. The minimum width tensile strength shall be 56 pounds per inch as specified in ASTM D4595. Fabric shall have a ¼ in x ¼ in mesh size with 50% open area. Coir matting shall be secured using dead stakes constructed from hardwood lumber, 1 in x 1 in with a length of 18 to 24 inches, cut diagonally across its length to form two stakes. Placement of the stakes shall be performed according to manufacturer recommendations for the coir matting.

PART 3 - EXECUTION

3.01 EXCAVATION

A. All excavation required for construction of in-stream structures will be considered incidental to that structure.

3.02 CONSTRUCTION

A. Rock cross vane

Rock cross vanes shall be constructed by first shaping the channel to the grades specified and then excavating to place the boulders and bed material. Footing boulders and surface boulders shall be placed at the center of the channel first to establish the correct invert elevation. Remaining footing and surface boulders shall be placed outward toward the banks, fitting tightly against each other to minimize gaps. Flat boulders should be located along the surface to create uniform vane arms. Footing boulders should be offset downstream of the surface boulders by a width of approximately 1/3 of the footing boulder. All footing boulders shall be a minimum of nine inches below stream invert. Smaller rocks may be used, as approved by the Engineer, but this may require more than two rows of boulders. The arm lengths shall tie into the bank according to the drawings. Geotextile fabric shall be used on the upstream face of the vane arms and shall be tied in below the footing boulders. Flow diverter boulders shall be placed along the upstream face of the vane in the center of the channel to create a random distribution of flow over the invert. Interstitial spaces on the upstream face of the vane shall be filled with gravel with hand placement of material where necessary to eliminate gaps. Vane arms should slope uniformly to the tie in location along the bank. Sill boulders should be placed along the top-of-bank surface where the vane arms tie into the bank. No footing boulders are necessary underneath the top-of-bank sills. Additional details on rock cross vane construction can be found in the drawings.

B. Log vane

Log vanes shall be constructed by first shaping the channel to the grades specified and then excavating to place the logs and bed material. Logs shall be placed starting near the center of the channel first and proceeding outward towards the banks as shown on the drawings. A portion of the log vane shall extend into the bed of the stream near the invert. Footing logs and surface logs should be placed and elevations checked before fully securing the logs. Footing logs should be offset slightly downstream from the surface logs and the footing logs and surface logs should be tightly spaced to minimize gaps. Geotextile fabric shall be placed along the upstream face and shall tie in below the footing log and be secured to the surface log on the upstream face of the structure using two-inch galvanized nails on 1-foot spacing. Excess fabric shall be removed and the nails and fabric shall be completely covered and not visible. The structure should be backfilled with gravel to minimize gaps. Anchor rods or rebar pins shall be used to secure both ends of the vane. The length of the pins should be long enough to extend through footing and surface logs with an excess of at least one foot. Boulders can be placed at the invert and bank tie-in to secure both the footing log and surface log, at the direction of the Engineer. Additional details on log vane construction can be found in the drawings.

C. Step pool

Step pools shall be constructed by first shaping the channel to the grades specified and then excavating to place the boulders and bed material. Footing boulders and surface boulders shall be first placed at the center of the channel at the upstream end of the structure to establish the correct invert elevation. Remaining footing and surface boulders shall be placed outward toward the banks, fitting tightly against each other to minimize gaps, before returning back to the center of the channel to complete the structure. Flat boulders should be located along the surface to create uniform grades. Footing boulders should be offset of the surface boulders by a width of approximately 1/3 of the footing boulder oriented towards the center of the step pool structure. All footing boulders shall be a minimum of nine inches below stream invert. Smaller rocks may be used, as approved by the Engineer, but this may require more than two rows of boulders. Geotextile fabric shall be used on the upstream face of the structure and shall be tied in below the footing boulders. Where multiple step pools are included in series, the surface boulders comprising the downstream portion of the first step pool can function as the surface boulders of the upstream portion of the second step pool, and so on. At these locations, footing boulders should be placed on both the upstream and downstream faces of the structure. Interstitial spaces on the upstream face of the structure shall be filled with gravel with hand placement of material where necessary to eliminate gaps. Additional details on step pool construction can be found in the drawings.

D. Imbricated rock wall

Imbricated rock walls shall be constructed by first excavating into the bank only as much as necessary to place the boulders with the slope of the cut face in the range of 1H:6V to 2H:6V. Footing boulders shall be set by trenching into the stream bed a minimum of 24 inches below the stream invert with additional footing depth where high potential for channel incision exists, as directed by the Engineer. The subgrade should be smooth, firm, and free from protruding objects or voids that would affect the proper positioning of the first layer of boulders. Geotextile fabric shall be placed so that it ties into the channel below the footing boulders and continues along the bank side of the imbricated rock wall. Fabric can be loosely placed along the cut bank until being secured behind the imbricated rock wall with placement of backfill with a minimum of three inches of stone behind the fabric. Adjacent strips should overlap a minimum of eight inches. Boulders shall be neatly stacked with staggered joints so that each boulder above the footing rests solidly on two boulders. Boulders should be rotated into the bank during placement such that the upstream boulders overlap the downstream boulders by a minimum of three inches. Placement of backfill should occur concurrently with the boulder placement, starting with backfilling the toe trench. Additional details on imbricated rock wall construction can be found in the drawings.

E. Riffle grade control

Riffle grade control shall be constructed by first shaping the channel to the grades specified and then excavating to place the boulders and bed material. Extend the excavation into the bank as necessary. Bed material should be placed in lifts that are less than one foot in depth. Dumping of riprap shall not be permitted. The surface of placed bedding material shall be imbricated by mixing the material on site before being placed and washing in fines after material is placed. Recycled river bed material may be used as a top dressing or mixed into the new bed material or to tie in the upstream and/or downstream extents of the riffle grade control. Additional details on riffle grade control construction can be found in the drawings.

F. Rock sill

Rock sills shall be constructed by first shaping the channel to the grades specified and then excavating to place the boulders and bed material. Footing boulders and surface boulders shall be placed at the center of the channel first to establish the correct invert elevation. Remaining footing and surface boulders shall be placed outward toward the banks, fitting tightly against each other to minimize gaps. Flat boulders should be located along the surface so that the sill remains flush with the channel bed. Footing boulders should be offset downstream of the surface boulders by a width of approximately 1/3 of the footing boulder. The sill lengths shall tie into the bank according to the drawings. Geotextile fabric shall be used on the upstream face of the vane arms and shall be tied in below the footing boulders.

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DIVISION 3

CONCRETE

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SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work included in this Section consists of providing all labor, materials and equipment necessary for providing and installing formwork for concrete.
- B. Related Work Described Elsewhere:
 - 1. Concrete Sidewalks: Section 02509.
 - 2. Concrete Reinforcement: Section 03200.
 - 3. Concrete Joints: Section 03262.
 - 4. Cast-in-Place Concrete: Section 03300.
- C. General Design and Responsibility:

Structural design responsibility: All forms and shoring shall be designed at the Contractor's expense by a Professional Engineer registered in the State of Georgia. Formwork shall be designed and erected in accordance with the requirements of ACI 301 and ACI 318 and as recommended in ACI 347 and shall comply with all applicable regulations and codes. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete. The Contractor shall be responsible for safety in its construction and removal.

1.02 QUALITY ASSURANCE

- A. Qualifications: Formwork shall be constructed in accordance with the specified standards, as well as all pertinent codes and regulations. Where provisions of pertinent codes conflict with the requirements of this section of these specifications, the more stringent provisions shall govern.
- B. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. American Concrete Institute (ACI):
 - a. ACI 347 - Guide for Concrete Formwork.

- b. ACI 301 - Specifications for Structural Concrete for Buildings.
 - c. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 2. American Plywood Association (APA):
 - a. Material grades and designations as specified.
 - 3. Building Codes:
 - a. Standard Building Code (SBCCI)
 - b. Local Codes and regulations.
- C. Preplacement checklist. The Contractor, as part of his Quality Control Plan, shall develop and submit for approval a Preplacement Checklist form to cover the following items:
 - 1. Reference Drawings covering the placement for all trades and disciplines.
 - 2. Date and time scheduled for placement and the actual date and time of placement.
 - 3. Foreman name, placement number, number of truckloads and number of cylinders.
 - 4. Checklist items such as embeds (list each), subgrade, rebar, forms, alignment, plumbness, etc.
 - 5. Signoff's for foreman, Contractor's Quality Control representative, each subcontractor foreman (major subs, mechanical, electrical, plumbing, etc.) and Engineer.
- D. No concrete may be placed until the checklist is properly and completely signed off. Failure to comply with this provision can be grounds for rejecting the work. The checklist shall be weather protected and located with the foreman or at the foreman's station.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01340, showing materials of construction and details of installation for:
 - 1. Location and sequence of the concrete placements. Indicate locations of joints and panel sizes and patterns. Show location of form ties on architectural surfaces.

2. Review of pour sequence, form system, and panel layout shall be for appearance and strength of the completed structure only. Review by the Engineer of forming plans or procedures shall not relieve the Contractor of responsibility for the strength, safety or correctness of methods used, the adequacy of equipment, or from carrying out the work in full compliance with the requirements of the Drawings and Specifications.

B. Samples:

1. The Contractor shall demonstrate to the Engineer on a designated area of the concrete substructure exterior surface that the form release agent will not adversely affect concrete surfaces to be painted, coated or otherwise furnished and will not affect the forming materials.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Form Lumber: Use form lumber when in contact with exposed concrete, conforming to one (1) of the following, a combination thereof, or equivalent as approved by the Engineer.

1. Lumber: Southern Pine No. 2 grade, seasoned, surfaced on four (4) sides.
2. Plywood: Shall be new and unused "Plyform", Class I or II, bearing the label of the American Plywood Association (Minimum 3/4 inch thickness).
 - a. All joints or gaps in forms shall be taped, gasketed, plugged, and/or caulked with an approved material so that the joint will remain watertight and will withstand placing pressures without bulging outward or creating surface patterns.

- B. Form Ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole. Use embedded rods with integral water stops and cones to provide a 1½ inch breakback. Wire ties and wood spreaders will not be permitted.

C. Form Release Agent:

1. Coat all forming surfaces in contact with concrete using an effective, non-staining, non-residual, water based, bond-breaking form coating that leaves the concrete with a paintable surface unless otherwise noted. Form release agents used in potable water containment structures shall be suitable for use in contact with potable water and shall be non-toxic and free of taste or odor.

- D. Chamfer Strips and Moldings: Chamfer strips shall be polyvinyl strips or approved equal, designed to be nailed in the forms to provide a 3/4 inch chamfer (unless indicated otherwise) at exposed edges of concrete members. Rectangular or trapezoidal moldings shall be placed in locations requiring sealants where specified or shown on the Drawings. Sizes of moldings shall conform to the sealants manufacturer's recommendations.
- E. Metal Forms: Metal forms may be used when approved by the Engineer and shall be of an appropriate type for the class of work involved.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Construction of Formwork: Forms shall be sufficiently strong to withstand the pressure resulting from the placement and vibration of concrete and shall be sufficiently rigid to maintain specified tolerances. Forms shall be sufficiently tight to prevent loss of mortar, and shall be adequately braced against lateral, upward or downward movement.
- B. Coating of Forms: Apply form coating to board forms prior to placing reinforcing. Keep form coatings off steel reinforcing, items to be embedded and previously placed concrete.
- C. Form Erection:
 - 1. Provide a means of holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects of the finished concrete. Insure that forms may be removed without injury to the surface of the finished concrete.
 - 2. Provide a positive means of adjustment of shores and struts. Insure that all settlement is taken up during concrete placing.
 - 3. Temporary openings shall be provided in wall forms to limit the free fall of concrete to a maximum of 6 feet unless an elephant trunk is used. Such openings shall be located to facilitate placing and consolidation and shall be spaced no more than 8 feet apart. Temporary openings shall also be provided in the bottom of wall and column forms and elsewhere as necessary to facilitate cleaning and observation immediately prior to placing.
 - 4. Do not embed any form-tying device or part thereof other than metal in concrete.

5. Form surfaces of concrete members except where placement of the concrete against the ground is shown on the drawings. The dimensions of concrete members shown on the Drawings apply to formed surfaces, except where otherwise indicated.

D. Formwork Reuse: Reuse only forms which maintain a uniform surface texture on exposed concrete surfaces. Apply light sanding between uses to obtain such a uniform texture. All surfaces to be in contact with concrete shall be thoroughly cleaned, all damaged places repaired, all projecting nails withdrawn and all protrusions smoothed. Plug unused tie rod holes with corks, shave flush, and sandpaper on the concrete surface side. Reuse of wooden forms for other than rough finish will be permitted only if a "like new" condition of the form is maintained.

E. Metal Forms:

Metal forms shall be thoroughly cleaned and mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface for all forms, except those utilized for surfaces receiving a rough finish. All forms shall have the contact surfaces coated with a release agent.

3.02 TOLERANCES

A. Concrete Tolerance:

1. Vertical, lateral, and level alignments and cross-sectional dimensions shall comply with ACI 117.
2. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

Maximum Tolerance	(inches)
Sleeves and Inserts	+1/4 to -1/4
Projected ends of anchors	+1/4 to 0.0
Anchor bolt setting	+1/4 to -1/4
Finished concrete, all locations	+1/4 to -1/4 per in. 10-feet of length

The planes or axes from which the above tolerances are to be measured shall be as follows:

Sleeves and Inserts	Centerline of sleeve or insert
Projected Ends of	Plane perpendicular to the end of the anchor

Anchor	As located on the Drawings.
Anchor Bolt Setting	Centerline of anchor bolt
Finish Concrete	The concrete surface as located on the Drawings.

- Where equipment is to be installed, comply with manufacturer's tolerances if more severe than above.

B. Form Tolerances:

- Forms shall be surfaced, designed, and constructed in accordance with the recommendations of ACI 347 and shall meet the following additional requirements for the specified finishes.
- Formed Surface Exposed to View: Edges of all form panels in contact with concrete shall be flush within 1/32-inch and forms for plane surfaces shall be such that the concrete will be plane within 1/16-inch in four feet. Forms shall be tight to prevent the passage of mortar, water and grout. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-inch from the intended surface as shown on the Drawings. Form panels shall be arranged symmetrically and in an orderly manner to minimize the number or seams.
- Formed surfaces not exposed to view or buried shall meet requirements of Class "C" Surface in ACI 347.
- Formed rough surfaces including mass concrete, pipe encasement, electrical duct encasement, and other similar installations shall have no minimum requirements for surface smoothness and surface deflections. The overall dimensions of the concrete shall be plus or minus 1-inch.
- Formed concrete Surfaces to Receive Paint: Surface deflections shall be limited to 1/32-inch at any point and the variation in wall deflection shall not exceed 1/16-inch per 4 feet. The maximum deviation of the finish wall surface at any point shall not exceed 1/4-inch from the intended surface as shown on the Drawings.

- C. Formed Openings: Openings shall be of sufficient size to permit final alignment of the items within it without deflection or offsets of any kind and to allow space for packing where the items pass through the wall to ensure water tightness around openings so formed. Provide openings with continuous keyways with waterstops where required, and provide a slight flare to facilitate grouting and the escape of entrained air during grouting. Provide formed openings with reinforcement as indicated and specified. Reinforcing steel shall be at least 2 inches clear from the opening.
- D. Embedded Items: Set anchor bolts and other embedded items accurately and hold securely in position in the forms until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check all nailing, blocks, plugs and strips necessary for the attachment of trim, finish and similar work prior to concreting.
- E. Pipes and Wall Spools Cast in Concrete:
 - 1. Install wall spools, wall flanges and wall anchors before placing concrete. Do not weld, tie or otherwise connect the wall spools to the reinforcing steel.
 - 2. Support pipe and fabricated fittings to be encased in concrete on concrete piers or pedestals. Carry concrete supports to firm foundations so that no settlement will be possible during construction.

3.03 REMOVAL OF FORMS

- A. The Contractor shall be responsible for all damage resulting from removal of forms. Forms and shoring for structural slabs or beams shall remain in place in accordance with ACI 301 and ACI 347. Form removal shall conform to the requirements specified in Section 03300, Cast-in-Place Concrete.

3.04 INSPECTION

- A. The Engineer shall be notified when the forms are complete and ready for inspection at least six hours prior to the proposed concrete placement.

- B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with requirements of these Specifications, shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced as approved by the Engineer at not addition cost to the Owner. Such repair or replacement shall be subject to the requirements of these Specifications and approval of the Engineer.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The work in this Section consists of providing all labor, materials, equipment and incidentals required to install all steel bars, steel wire and wire fabric required for the reinforcement of concrete, as shown on the Drawings, and as specified herein.
- B. Related Work Described Elsewhere:
 - 1. Concrete Formwork: Section 03100.
 - 2. Cast-in-Place Concrete: Section 03300.

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the following standards:
 - 1. American Concrete Institute (ACI)
 - a. ACI 117 - Standard Tolerance for Concrete Construction and Materials.
 - b. ACI 301 - Specifications for Structural Concrete.
 - c. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - d. ACI 350R - Environmental Engineering Concrete Structures.
 - e. ACI 315 - ACI Detailing Manual.
 - 2. American Society for Testing and Materials (ASTM)
 - a. ASTM A82 - Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. ASTM A184 - Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.

- c. ASTM A185 - Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
 - d. ASTM A496 - Specification for Steel Wire Deformed, for Concrete Reinforcement.
 - e. ASTM A497 - Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - f. ASTM A615 - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 - g. ASTM A767 - Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
 - h. ASTM A775 - Specification for Epoxy-Coated Reinforcing Steel Bars.
 - i. ASTM A884 - Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
- 3. American Welding Society (AWS)
 - a. AWS D1.4 Structural Welding Code - Reinforcing Steel.
 - 4. Concrete Reinforcing Steel Institute (CRSI)
 - a. CRSI Manual of Standard Practices.
 - 5. Building Codes
 - a. Standard Building Code (SBCCI).
 - b. Local codes and regulations.

1.03 SUBMITTALS

A. Materials and Shop Drawings:

- 1. Submit mill test certificates identifying chemical and physical analyses for each load of reinforcing steel delivered.

- B. Submit shop drawings for review in accordance with Section 01340: Shop Drawings, Working Drawings and Samples. Submit reinforcing bending lists and placing drawings for all reinforcing. Placing drawings shall include wall elevations, plan views, and sections to clearly show the reinforcing placing procedures. Placing drawings shall indicate all openings (mechanical, electrical, equipment), including additional reinforcing at openings and intersecting wall, beam and footing arrangements as indicated on the structural drawings and specified herein. Placing drawings shall be coordinated with the concrete placing schedule. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, floor or beams), including all dowels and other bars as required. Furnishing such lists shall not be construed that the list will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Reinforcement shall be shipped to the work with bars of the same size and shape fastened in bundles with metal identification tags with waterproof markings giving size and mark securely wired on. The identification tags shall be labeled with the same designation as shown on the submitted bar lists and shop drawings.
- B. All bars shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete reinforcement in sizes No. 3 (3/8 inch) and larger shall be deformed steel bars of the same sizes and shapes indicated on the Drawings. The steel shall be newly rolled stock of domestic manufacture, substantially free from mill scale, rust, dirt, grease, or other foreign matter. Bars shall be of intermediate grade, deformed billet steel conforming to ASTM Specification A-615, Grade 60, including all supplementary requirements.
- B. Rail-steel bars will not be allowed in the work.

- C. Reinforcement shall be accurately fabricated to the dimensions indicated on the Drawings. Particular care shall be exercised not to have stirrups oversized in order to maintain proper coverage of concrete. Stirrups and tie bars shall be made around a pin having a diameter not less than two (2) times the maximum thickness of the bar. Bends for other bars shall be made around a pin having a diameter not less than five (5) times the minimum thickness of the bar except for bars larger than 1 inch, in which case the bends shall be made around a pin of eight (8) bar diameters. All bars shall be bent cold. Bars reduced in section or with kinks or bends not shown on the Drawings will not be accepted.
- D. Wire fabric shall conform to ASTM Specification A-185, galvanized for Welded Steel Wire Fabric for Concrete Reinforcement. Welded wire fabric shall be furnished in flat sheets, rolled WWF is not permitted.
- E. Wire tie shall be 16-gauge minimum, zinc coated annealed, conforming to ASTM Specification A82.
- F. Bar supports in beams and slabs exposed to view after for stripping shall be galvanized or plastic coated. Use concrete supports for reinforcing in concrete placed on grade.
- G. Coupler Splice Devices: Tension couplers capable of developing the ultimate strength of the bar as manufactured by Erico Products Inc., Solon, Ohio, or equal and where approved by the Engineer.
- H. Reinforcing Steel Accessories
 - 1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.
 - 2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.
 - 3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Surface condition, bending, spacing, and tolerances of placement of reinforcement shall comply with the CRSI. The CONTRACTOR shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.

- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
1. Concrete cast against and permanently exposed to earth: 3-in.
 2. Concrete exposed to soil, water, sewage, or weather: 2-in.
 3. Concrete not exposed to soil, water, sewage, or weather:
 - a. Slabs (top and bottom cover), walls and joists: 3/4 in.
 - b. Beams and columns (principal reinforcement, ties, spirals, and stirrups) 1-1/2 inc.
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference, shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement by using zinc coated wire ties of not less than No. 16 gauge or suitable clips at intersections. Secure dowels in place before placing concrete.
- G. Do not press dowels into the concrete after the concrete has been placed.

- H. Flat sheet wire mesh shall be placed as follows. Support and tie mesh to prevent movement during concrete placement. Support welded wire fabric by high chairs or bolster with baseplates, all plastic supports, and concrete blocks. It is not permissible to place the WWF on the subbase and pulling it up or laying the WWF on top of the concrete and walking it into the concrete. Extend fabric to within 2 inches of the edges of the slab and lap splices at least 1-1/2 courses of the fabric and a minimum of 6 inches. Tie laps and splices securely at ends and at least every 24 inches with 16 gauge annealed steel wire.
- I. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as approved by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.02 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.03 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with the applicable tables in the ACI 315. Splices in adjacent bars shall be staggered. Class A splices shall be used when 50 percent or less of the bars are splices within the required lap length. Class B splices shall be used at all other locations.
- C. Except as otherwise indicated on the Drawings, splices in circumferential reinforcement in circular walls shall be Class B tension splices and shall be staggered. Adjacent bars shall not be spliced within the required lap length.

- D. Install wire fabric in as long lengths as practicable. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The splices fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.

3.04 ACCESSORIES

- A. The Contractor shall be solely responsible for determining, providing and installing accessories such as chairs, chair bars, and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.05 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given at least 24 hours advance notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his observations of the reinforcing steel.

END OF SECTION

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SECTION 03262

CONCRETE JOINTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The work included in this section consists of providing all labor, materials and equipment necessary to install expansion joints, construction joints, and waterstops.
- B. Related Work Described Elsewhere:
 - 1. Concrete Walkways: Section 02515.
 - 2. Concrete Formwork: Section 03100.
 - 3. Concrete Reinforcement: Section 03200.
 - 4. Cast-in-place Concrete: Section 03300.

1.02 SUBMITTALS

- A. Materials: Submit manufacturer's literature, materials and samples of waterstops in accordance with Section 01340: Shop Drawings, Working Drawings and Samples including a statement of compliance with ASTM and U.S. Federal Specifications. Manufacturer shall demonstrate five (5) years, minimum, of continuous, successful experience in their product line.
 - 1. Premolded joint fillers: Product data including catalog cut, technical data, storage requirements, installation requirements, location of use, and conformance to ASTM standards.
 - 2. Bonding agents: Product data including catalog cut, technical data, storage requirements, product life, application requirements, and conformance to ASTM standards.
- B. Certifications
 - 1. Certification from the manufacturer that all materials used within the joint system are compatible with each other.

1.04 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C881 - Epoxy-Resin-Base Bonding Systems for Concrete.
 - 2. ASTM C1059 - Latex Agnets for Bonding Fresh to Hardened Concrete.
 - 3. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store all products under tarps to protect from oil, dirt and sunlight.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of manufacture's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (joint fillers, sealants, etc.) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility.

2.02 MATERIALS

- A. Premolded Joint Filler
 - 1. Premolded joint filler - sidewalk and roadway concrete pavements. Joints where fiber is specifically noted on the Drawings, shall be asphalt-impregnated fiber board. Joint filler shall conform to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.
- B. Bonding Agent
 - 1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type V.
 - 2. Latex bonding agent shall be a non-re-emulsifiable acrylic-polymer latex conforming to ASTM C1059 Type II.

C. Joint Sealant

1. Joint sealant for continuous immersion shall be a multipart, gray, polyurethane sealant meeting U.S. Federal Specification TT-S-00227E (3) Type I, Class A for horizontal joints and Type II, Class A for vertical joints. Additionally, the sealant must be recommended by the manufacturer for continuous immersion in water.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Construction Joints:

1. Provide construction joints where shown on the Drawings, or as recommended by the Contractor and approved by the Engineer. In case of emergency, place additional construction joints. (An interval of 45 minutes between two consecutive batches of concrete shall constitute cause for an emergency construction joint.)
2. Construction joints shall be keyed, unless otherwise detailed. Form keyways by beveled strips or boards placed at right angles to the direction of shear. Except where otherwise shown on the Drawings or specified, keyways shall be at least 1-1/2 inches in depth over at least 25 percent (25%) of the area of the section.
3. When it is necessary to make a joint because of an emergency, furnish and place reinforcing dowels across the joint. Embed dowels 48 bar diameters each side of the joint. Size and number of dowels shall match reinforcing in the member. Furnishing and placing such reinforcing steel shall be at the Contractor's expenses.
4. After the pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material, and expose clean aggregate by sandblasting the surface of construction joints before placing the new concrete. At least two hours before and again shortly before the new concrete is deposited, the joints shall be saturated with water. After glistening water disappears, the joints shall be given a thorough coating of neat cement slurry mixed to the consistency of very heavy paste. The surfaces shall receive a coating at least 1/8-in thick, well scrubbed-in by means of stiff bristle brushes whenever possible. New concrete shall be deposited before the neat cement dries.

- B. Expansion Joints:
1. Provide expansion joints of sizes and at locations as shown on the Drawing.
 2. Place expansion joint fillers every 30 feet in straight runs of walkways, at right angles turns and wherever concrete butts into vertical surfaces.
- C. Bonding at Construction Joints: Before depositing new concrete on or against concrete that has set, thoroughly clean the surfaces of the set concrete so as to expose the coarse aggregate and remove laitance coatings, foreign matter and loose particles. Retighten forms. Dampen, but do not saturate the hardened concrete of joints and then thoroughly cover with a coat of cement grout of similar proportions to the mortar in the concrete. Place the fresh concrete before the grout has attained its initial set.
- D. Time Between Pours: At least 2 hours shall elapse after depositing concrete in columns or walls before depositing in beams, girders or slabs supported thereon. Place beams, girders, brackets, column capitals and haunches monolithically as part of the floor or roof system.
- E. Joint Sealants: Joint sealants shall be required where indicated on the Drawings. Preparation of surfaces, priming and the handling and preparation of materials shall be in complete compliance with the manufacture's instructions as approved.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The Contractor shall furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.
- B. Related Work Described Elsewhere:
 - 1. Concrete Formwork: Section 03100.
 - 2. Concrete Reinforcement: Section 03200.
 - 3. Concrete Joints: Section 03262.

1.02 QUALITY ASSURANCE

- A. Standards: Unless otherwise indicated, all materials, workmanship and practices shall conform to the requirements of the following standards:
 - 1. American Concrete Institute (ACI)
 - a. ACI 301 - Specifications for Structural Concrete.
 - b. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
 - c. ACI 305 - Hot Weather Concreting.
 - d. ACI 306 - Cold Weather Concreting.
 - e. ACI 308 - Standard Practice for Curing Concrete.
 - f. ACI 309 - Guide for Consolidation of Concrete.
 - g. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - h. ACI 347 - Guide for Concrete Formwork.
 - i. ACI 350 - Environmental Engineering Concrete Structures.

2. American Society for Testing and Materials (ASTM)
 - a. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
 - b. ASTM C33 - Concrete Aggregates.
 - c. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens.
 - d. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - e. ASTM C94 - Standard Specification for Ready-mix Concrete.
 - f. ASTM C143 - Slump for Portland Cement Concrete.
 - g. ASTM C150 - Standard Specification for Portland Cement.
 - h. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - i. ASTM C173 - Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - j. ASTM C231 - Air Content of Freshly Mixed Concrete by the Pressure Method.
 - k. ASTM C260 - Air Entraining Admixtures for Concrete.
 - l. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
 - m. ASTM C494 - Chemical Admixtures for Concrete.
 - n. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
3. Building Codes
 - a. Standard Building Code (SBCCI).
 - b. Local Codes and Regulations.

- B. Plant Qualification: Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C-94.

1.03 SUBMITTALS

- A. **Materials and Shop Drawings:** The following information shall be submitted for approval in accordance with Section 01340: Shop Drawings, Working Drawings and Samples. No concrete shall be furnished until submittal has been approved.
1. **Plant Qualification:** Satisfactory evidence shall be submitted indicating compliance with the specified qualification requirements.
 2. **Materials:** Satisfactory evidence shall be submitted indicating that materials to be used, including cement, aggregates and admixtures meet the specified requirements. Provide catalog data, chemical and mechanical analysis, and conformance with ASTM requirements.
 - a. Sources of cement, pozzolan and aggregates.
 - b. Air-entraining admixture.
 - c. Water reducing admixture.
 - d. High range water-reducing admixture (plasticizer).
 - e. Sheet curing material.
 - f. Liquid curing compound.
 3. **Design Mix:** The design mix to be used shall be prepared by qualified persons and submitted for approval. The design of the mix is the responsibility of the Contractor subject to the limitations of the Specifications. Approval of this submission will be required only as minimum requirements of the Specifications have been met. Such approval will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the Specifications relative to strength and slump.
 4. **Ready Mix Concrete:** Provide delivery tickets or weighmasters certificate per ASTM C-94, including weights of cement and each size aggregate, amount of water in the aggregate, and amount of water added at the plant. Write in the amount of water added on the job.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement

1. Cement for all concrete shall be domestic Portland cement that conforms to the requirements of ASTM Designation C-150 Type I or Type II. Cement for high early strength concrete shall be used only for special locations and only with the approval of the Engineer. Type I cement may be used for buildings and tremie concrete.
2. Only one (1) brand of cement shall be used in any individual structure unless approved by the Engineer. Cement which has become damaged, partially set, lumpy or caked shall not be used and the entire contents of the sack or container which contains such cement will be rejected. No salvaged or reclaimed cement shall be used.

B. Pozzolan

1. Fly ash shall be Class C or F conforming to the requirements of ASTM C618, including the requirements of Table 1 except the loss of ignition, LOI, shall be limited to 3% maximum. Fly ash shall not exceed 20% of the cementitious content of the mix.

C. Aggregates

1. ASTM C-33. Coarse aggregates shall be size No. 57 (1 inch). Block cell fill shall be size #8.

D. Water: Clean and free from injurious amounts of deleterious materials.

E. Air Entraining Admixture: ASTM C-260.

F. Water Reducing and Retarding Admixtures:

1. For concrete without superplasticizer: ASTM C-494, Type D, and shall contain no calcium chloride by weight of cement.

G. Curing Compound: ASTM C-309, Type 1. The compound shall contain no ingredient which will adversely affect the bond of coatings or toppings. Curing compound shall be approved for use in contact with potable water after 30 days.

1. Curing compound for exposed concrete not to receive special finishes, protective coatings and/or concrete toppings shall be "Super Rez-Seal", as manufactured by Euclid Chemical Co., Cleveland, Ohio or equal.

2. Curing compound for exposed concrete to receive special finishes, protective coatings and/or concrete toppings shall be "Kurez-DR", as manufactured by Euclid Chemical Co., Cleveland, Ohio or equal.
- H. Mortar for Repair of Concrete: Mortar used for repair of concrete shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than one (1) part cement to two and one-half (2-1/2) parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.
- I. Burlap Mats: Conform to AASHTO Specification M-182.
- J. Epoxy Bonding Agent: Sikadur 32 Hi Mod, or equal.

2.02 MIXES

A. General Requirements:

1. Mix Design: Proportioning shall be on the basis of field experience and/or trial mixtures as specified in ACI-318, Section 4.3. Data on consecutive compression tests and standard deviation shall be submitted. Proportioning for small structures may be by the water/cement ratio under special approval by the Engineer. Concrete mix design shall comply with the Standard Building Code requirements.
2. Air Content: Range 3.5 to 6% for Class A and B.
3. Slump: 4 inches plus or minus 1 inch for Class A and B.

6 inches plus or minus 1 inch for tremie concrete.
4. Water cement ratio = 0.45 (Class A Concrete)

= 0.55 (Class B Concrete)
5. Minimum Compressive Strength at 28 days:
 - a. Class A, 4,000 psi: Columns, walls, elevated slabs including footings, tanks, ditches, pumping station, tremie concrete and other concrete in contact with treated waters.
 - b. Class B, 3,000 psi: Slabs and mats on grade, masonry fillcell grout, encasements, thrust blocks, and pipe supports, concrete curbs, fills and sidewalks, etc. not in contact with treated waters.

B. Production of Concrete:

1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C-94, except as otherwise indicated.
2. Air Entraining Admixture: Air entraining admixture shall be charged into the mixture as a solution and shall be measured by means of an approved mechanical dispensing device. The liquid shall be considered a part of the mixing water.
3. Water Reducing and Retarding Admixture: Water reducing and retarding admixture shall be added and measured as recommended by the manufacturer. The addition of the admixture shall be separate from the air entraining admixture. The addition of the admixture shall be completed within one minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first. Admixtures shall be stored, handled and batched in accordance with the recommendation of ASTM C-94.

C. Delivery Tickets: In addition to the information required by ASTM C-94, delivery tickets shall indicate the cement content and the water/cement ratio.

D. Temperatures: The temperature of the concrete upon delivery from the truck shall not exceed 95 degrees Fahrenheit (°F), otherwise ice shall be used to reduce the temperature of the concrete as recommended by ACI.

E. Modifications To The Mix: No modifications to the mix shall be made in the plant or on the job which will decrease the cement content or increase the water-cement ratio beyond that specified. No modifications of any kind shall be made except by a qualified and responsible representative of the concrete producer.

1. Any addition of water must be approved by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket. Addition of water shall follow procedures of ASTM C-94 for slump adjustment.

PART 3 - EXECUTION

3.01 PREPARATION

A. Preparations Before Placing: No concrete shall be placed until the approval of the Engineer has been received. Approval will not be granted until forms are thoroughly clean, and reinforcing and all other items required to be set in concrete have been placed and thoroughly secured. The Engineer shall be notified a minimum of 24 hours before concrete is placed.

B. Conveying:

1. General: Concrete shall be handled from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete. No concrete shall be placed more than 90 minutes after mixing has begun for that particular batch.
2. Buckets and Hoppers: Buckets and hoppers shall have discharge gates with a clear opening equal to no less than one-third of the maximum interior horizontal area, or five (5) times the maximum aggregate size being used. Side slopes shall be no less than 60 degrees. Controls on gates shall permit opening and closing during the discharge cycle. It is suggested the Contractor provide one (1) standby bucket and hopper for use in case of equipment failure.
3. Runways: Extreme care shall be exercised to avoid displacement of reinforcing during the placing of concrete.
4. Elephant Trunks: Hoppers and elephant trunks shall be used to prevent the free fall of concrete for more than 6 feet.
5. Chutes: Chutes shall be metal or metal lined, and shall have a slope not exceeding one vertical to two horizontal, and not less than one vertical to three horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements, may be used only if they discharge into a hopper before distribution.
6. Pumping Equipment: Pumping equipment and procedures, if used, shall conform to the recommendations contained in the report of ACI Committee 304 on "Placing Concrete by Pumping Methods", ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2 inches.
7. Conveying Equipment Construction: Aluminum or aluminum alloy pipe for tremies or pump lines and chutes, except for short lengths at the truck mixer shall not be permitted.
8. Cleaning: Conveying equipment shall be cleaned at the end of each concrete operation.

3.02 APPLICATION

A. Placing:

1. General: Concrete shall be deposited continuously, or in layer of such thickness (not exceeding 2 feet in depth) that no concrete will be deposited on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness.
2. Supported Elements: At least 2 hours shall elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon.
3. Segregation: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures which will cause segregation.
4. Concrete Under Water: All concrete, except that indicated on the Drawings as Tremie concrete, shall be placed in the dry.
5. Concrete Fill and Tank Bottom Slab: Concrete fill for the tank bottoms, where shown on Drawings, shall be placed within the tolerances described in this Section and as per equipment manufacturer's recommendations.

B. Seals and Tremie Concrete:

1. General:
 - a. Wherever practicable, all foundation excavations shall be dewatered and the concrete deposited in the dry. Where conditions are encountered which render it impracticable to dewater the foundation before placing concrete, a concrete foundation seal shall be placed. The foundation shall then be dewatered, and the balance of the concrete placed in the dry.
 - b. When seal concrete is required to be placed, the satisfactory performance of the seal in providing a watertight excavation for placing structural concrete shall be the responsibility of the Contractor. Seal concrete placed by the Contractor, which subsequently fails to perform properly, shall be repaired as necessary to perform its required function, at the expense of the Contractor.
2. Method of Placing: Concrete deposited under water shall be carefully placed in the space in which it is to remain by means of a tremie, a closed-bottom dump bucket of not less than one cubic yard capacity, or other approved method, and shall not be disturbed after it is deposited. All seal

concrete shall be deposited in one (1) continuous pour. No concrete shall be placed in running water. All form work designed to retain concrete under water shall be watertight, and the design of the form work and excavation sheeting shall be by a Professional Engineer, registered in the State of Georgia.

3. Use of Tremie: The tremie shall consist of a tube having a minimum inside diameter of 10 inches, and shall be constructed in sections having tight joints. No aluminum parts which have contact with the concrete will be permitted. The discharge end shall be entirely seated at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper the tremie shall be slightly raised (but not out of the concrete at the bottom) until the batch discharges to the bottom of the hopper, after which the flow shall be stopped by lowering the tremie. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the entire top surface of the work, and shall permit it being lowered rapidly when necessary to choke off or retard the flow. The flow shall preferably be continuous and in no case shall be interrupted until the work is completed. Special care shall be exercised to maintain still water at the point of deposit.
4. Use of Bottom-dump Bucket: When the concrete is placed by means of a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. The bucket shall then be raised very slowly during the discharge travel; the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture. Aluminum buckets will not be permitted.
5. Time of Beginning Pumping: Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure, and in no case earlier than 72 hours after placement of the concrete.

C. Consolidating Concrete:

1. General: Concrete, with the exception of slabs less than 8 inches thick, shall be consolidated by means of internal vibrators operated by competent workmen.
 - a. Concrete Slabs: Concrete for slabs less than 8 inches shall be consolidated with vibrating screeds; slabs 8-inches to 12-inches thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.

2. **Vibrators:** Vibrators shall have a minimum head diameter of at least 2 inches, a minimum centrifugal force of 700 and a minimum frequency of 8,000 vibrations per minute.
 3. **Vibrators for Confined Areas:** In confined areas, the specified vibrators shall be supplemented by others having a minimum head diameter of 1-1/2 inches, a minimum centrifugal force of 300 pounds and a minimum frequency of 9,000 vibrations per minute.
 4. **Spare Vibrator:** One (1) spare vibrator for each three (3) in use shall be kept on the site during all concrete placing operations.
 5. **Use of Vibrators:** Vibrators shall be inserted and withdrawn at points approximately 18 inches apart. The duration of each insertion shall be from 5 to 15 seconds. Concrete shall not be transported in the forms by means of vibrators.
- D. **Protection:** Rainwater shall not be allowed to increase the mixing water, nor to damage the surface finish. Concrete shall be protected from construction overloads. Design loads shall not be applied until the specified strength has been attained.
- E. **Construction Joints:** Except as otherwise indicated on the Drawings, horizontal construction joints shall be provided at top of foundation members and slabs on grade and at the soffit of supported slabs and beams. Other horizontal and vertical construction joints shall be located as indicated on the Drawings. Joints will not be permitted except in the locations shown, unless recommended by the Contractor and approved by the Engineer.
- F. **Bonding:** Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coating, foreign matter and loose particles. Forms shall be retightened. The hardened concrete of joints shall be dampened, but not saturated, and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inches thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
- G. **Embedded Items:** In addition to steel reinforcement, pipes, inserts and other metal objects as shown, specified or ordered shall be built into, set in or attached to the concrete. All necessary precautions shall be taken to prevent these objects from being displaced, broken or deformed. Before concrete is placed, care shall be taken to determine that all embedded parts are firmly and securely fastened in place as indicated. They shall be thoroughly clean and free from paint or other coating, rust, scale, oil, or any foreign matter. No wood shall be embedded in concrete. The concrete shall be packed tightly around pipes and other metal work to prevent

leakage and to secure proper adhesion. Drains shall be adequately protected from intrusion of concrete.

H. Concrete Finishes: Complete concrete surfaces in accordance with the following schedule:

1. Finish
Designation Area Applied
- F-1 Exterior walls below grade not exposed to water. Repair defective concrete, fill depressions deeper than 1/2 inch and fill tie holes.
- F-2 Exterior and interior walls of all structures. Repair defective concrete, remove fins, fill depressions and fill tie holes.
- F-3 Walls of all structures exposed to public view that will not be finish coated or sealed. In addition to Finish F-2, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry within 72 hours of removing forms consisting of one part cement and one and one-half parts sand by volume on the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.
- E-1 Exposed edges of slabs, floors and tops of walls. Finish with a 1/4 inch radius edge if a chamfer is not indicated.
- E-2 Tops of walls, beams and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of formed surfaces.
2. General: As soon as forms can safely be removed, all irregular projections shall be chipped off flush with the concrete surfaces. All voids produced by spacers or any honeycombing shall be pointed up with grout and troweled flush with the concrete surface immediately after removal of forms and water cured to prevent shrinkage. Honeycombing shall be cut out to expose a sound concrete surface prior to pointing. The use of mortar pointing or patching shall be confined to the repair of small defects in relatively green concrete. Where in the opinion of the Engineer substantial repairs are required, the defective concrete shall be cut out to sound concrete and repaired with gunite or the concrete shall be removed and reconstructed as directed.

3. All concrete slabs to be troweled shall receive a floated finish. After floating, all concrete slabs except as otherwise indicated and in areas to receive roofing, insulation, tile or topping shall be troweled and immediately light broom finished. Stair treads shall receive a light broomed finish.
4. Floated Finish: After concrete has been placed. Consolidated, struck off and leveled, it shall not be worked further until water sheen has disappeared and the surface has hardened sufficiently to permit floating, the planeness of the slab shall be checked with a 10 foot straightedge applied at no less than two (2) angles. All high spots shall be cut down and all low spots shall be filled to produce a surface having a Class B Tolerance throughout. The slab shall then be refloated to a uniform sandy texture.
5. Light Broomed Finish: After floating, slabs to receive a light broomed finish shall be power troweled and finished struck with a soft broom rag. The troweling shall produce a smooth surface, relatively free of defects and a Class B Tolerance. Before the surface sets, the soft broom drag shall be passed over the surface to produce a surface uniform in texture and appearance.
6. Troweled Finish: After floating, slabs to receive a troweled finish shall be power troweled and finally hand troweled. The first troweling after power floating shall produce a smooth surface, relatively free of defects. Surfaces shall be hand troweled after the surface has hardened sufficiently. The final troweling shall be done by hand when a ringing sound is produced as the trowel is moved over the surfaces. Hand troweling shall produce a surface which is thoroughly consolidated, free from trowel marks, uniform in texture and appearance and plane to a Class B tolerance.
7. Finishing Tolerance: Surfaces shall be true planes within the following limits:
 - a. Class B: 1/4 inch in 10 feet is determined by a 10 foot straightedge placed anywhere on the slab in any direction.
- I. Saw cut Joints: Joints that are to be saw cut shall be cut not sooner than 2 hours after the concrete is poured and not later than 8 hours after the pour.

3.03 PROTECTING

A. Curing:

1. All exposed surfaces, including slabs, walls, beams and columns shall receive a spray coat of curing compound applied in accordance with the manufacturer's recommendations. Exposed steel keyways and other embedded items shall be protected from the curing compound. Concrete surfaces for water retaining structures and/or to be coated with an epoxy system, shall be cured by the wet burlap method.
2. Curing compound shall be uniformly applied to the surfaces to be cured, in a single coat, continuous film by a mechanical sprayer. Application shall be in compliance with the manufacturer's recommendations.
3. Curing compound shall be applied in accordance with manufacturer's instructions. Should the film become damaged from any cause within the repaired curing period, the damaged portions shall be required immediately with additional compound. Upon removal of forms, the newly exposed surfaces shall immediately be coated to provide a curing treatment equal to that provided for the surface.

B. Wet Burlap Curing Method: All concrete for water retaining structures to be cured by the wet burlap method. All concrete shall be covered with a double thickness of burlap, cotton mats, or other approved material kept thoroughly saturated with water. The forms shall be kept wet until removed and upon removal, the curing specified herein shall be started immediately. Concrete shall be cured for a period of 7 days for normal Portland cement or 4 days for high early strength cement. Concrete poured in the dry shall not be submerged until it has attained sufficient strength to adequately sustain the stress involved nor shall it be subjected to flowing water across its surface until it has cured 4 days. Curing the gunite shall be started as soon as possible without damaging surface and not later than 2 hours after placing. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.

C. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.

3.04 REMOVAL OF FORMS

A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 70 percent of the 28 day compressive strength prescribed by the design, nor before reaching the following number of day-degrees of curing (whichever is the longer):

TABLE 4

<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

- B. Shores shall not be removed until the concrete has attained at least 60 percent of the specified strength and also sufficient strength to support safely its own weight and the construction live loads upon it.

3.05 TESTING

- A. A testing laboratory employed by the Contractor will make such tests required.
- B. Standard laboratory compressive test cylinders will be obtained by the laboratory when concrete is discharged at the point placing (i.e., discharge end of pumping equipment), and cylinders will be made and cured in accordance with the requirements of ASTM Designation C-31. A set of five (5) cylinders will be obtained for each 50 cubic yards, or fraction thereof placed each day, nor less than once for each 5,000 sq. ft. or surface area of slabs or walls for each type of concrete. The cylinders will be cured under laboratory conditions and will be tested in two groups of two (2) at 7 and 28 days of age, with one (1) group held until released by the Engineer in accordance with the requirements of ASTM Designation C-39.
- C. The laboratory will conduct tests of Class A and Class B concrete as it is discharged from the mixer at the point of placing. Slump tests will be made for each truckload of concrete. Slump tests may be made on any batch, and failure to meet specified slump requirements will be sufficient cause for rejection of the batch. If water is added after initial test then the "load" shall be tested.
- D. Air content of the concrete mixture will be tested on every other truck in accordance with ASTM C173 or ASTM C231.
- E. Historical strength/break data may be submitted with mix design and may be used in the approval process provided the mix design is otherwise acceptable. If the mix design required modifications, a test batch may still be required.

3.06 FIELD CONTROL

- A. The Contractor shall advise the Engineer of his readiness to proceed at least twenty four (24) working hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing and the alignment and tightness of formwork. No placement shall be made without the prior approval of the Engineer.

1. The Contractor's Superintendent shall submit a certification that indicates preparedness to place concrete and is in accord with contract drawings and specifications. This certification shall be submitted on forms provided by the Engineer.
- B. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of test on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- C. The Contractor shall cooperate in obtaining cores by allowing free access to the Work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. The Contractor shall repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner.

3.07 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and testing in compliance with the previous provisions fall below the values given in Section 2.02.A.5, the Engineer shall have the right to require changes in proportions outlined to apply on the remainder of the Work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In cases of failure to meet strength requirements the Contractor shall adjust the concrete mix to meet contract requirements.
- B. When the tests on control specimens of concrete fall below the required strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In case of failure of the core, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Test need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 85 percent of the required minimum 28 day strength, the concrete shall be rejected and shall be removed and replaced.

3.08 PATCHING

- A. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed, recesses left by the removal of form ties shall be filled, and surface defect which do not impair structural strength shall be repaired. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- B. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100-Concrete Formwork. Holes are then to be promptly filled upon stripping as follows: Moisten the hole with water, followed by a 1/16-inch brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch. Compact the grout into the hole until dense and an excess of paste appears on the surface. Trowel smooth with heavy pressure. Avoid burnishing.
- C. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of one to five days if necessary to bring the surface down to the adjacent concrete. Exercise care to avoid damaging or staining the surrounding concrete. Wash thoroughly to remove all rubbed matter.

3.09 REPAIRS

- A. It is the intent of these Specifications to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will not require patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified.
 - 1. General: Surface defects, including tie holes shall be repaired immediately after form removal. The areas to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. The Engineer shall be notified prior to commencing operations.
 - 2. Removal of Defective Concrete: All honeycombed and other defective concrete shall be removed down to sound concrete. Edges shall be cut perpendicular to the surface or slightly under cut. Sand blast surfaces to receive repair.
 - 3. Bonding Grout: Surfaces to be patched shall be thoroughly dampened and shall receive a coat of bonding grout brushed into the surface. Grout shall

consist of one part cement to one part fine sand passing a No. 30 sieve. Grout shall be the consistency of thick cream.

4. Placing Patching Mortar: After the bonding grout begins to lose its water sheen, a premixed patching mortar shall be applied. Patching mortar shall be thoroughly consolidated into place and stuck off so as to leave the patch slightly higher than the surrounding surface. It shall be left undisturbed for one hour to permit initial shrinkage and then finally finished.
5. Tie Holes: After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.

3.10 MISCELLANEOUS WORK

- A. All bolts, anchors, miscellaneous metals or other sleeves and steel work required to be set in the concrete forms for attachment of masonry, structural, and mechanical equipment shall be set or installed under this Section. The Contractor shall be fully responsible for the setting of such materials in the forms and shall correct all such not installed in a proper location or manner at his own expense. Contractor shall coordinate the activities of other trades for installation of these items.
- B. Electric conduits shall be installed in the concrete as required by the Drawings and specified elsewhere in these Specifications. Outlet boxes and fixtures shall be located in reference to the final floor, wall or ceiling finish and shall be as secured that they will not be displaced by concrete placing.
- C. Pipes or conduits for embedment, other than those merely passing through shall not be larger in outside diameter than one-third the thickness of the slab, wall, or beam in which they are embedded, unless indicated on the Drawings, nor shall they be spaced closer than three (3) diameters on center, nor so located as to unduly impair the strength of the construction. The Engineer shall approve the location of all conduits and fixtures.
- D. Concrete foundations, supports and bases for all equipment and machinery shall be built to the equipment manufacturer's requirements, as approved by the Engineer, with anchor bolts installed.

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SECTION 03410

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work:

1. The contractor shall furnish all materials, labor and equipment and construct culvert, headwalls, inlets, and other applicable items, as shown on the Drawings and as specified herein.
2. The precast culvert, wing walls, and appurtenances shall meet either GDOT specifications or ASTM C1577 as conditions require.
3. The forms, dimensions, concrete, and construction methods shall be approved by the Engineer in advance of construction.

B. Related Work Described Elsewhere:

1. Earthwork: Section 02200.
2. Cast-in Place Concrete: Section 03300.

1.02 SUBMITTALS

- ###### A. Submit to the Engineer Shop Drawings showing details of construction, reinforcing and joints.

1.03 INSPECTION

- ###### A. The quality of all materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Construction Manager, or other representatives of the Owner. Such inspection may be made at the place of manufacture, at the site after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.

- B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.
- C. Imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of 7 days and 5,000 psi at the end of 28 days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2 - PRODUCT

2.01 PRECAST CONCRETE SECTIONS

- A. Precast reinforced concrete box culverts, wing walls, and parapets shall be in accordance with GDOT specification 513 or ASTM C1577 as required.
- B. The following are acceptable manufacturers:
 - 1. Foley Company
 - 2. Hanson Pipe and Precast
 - 3. Old Castle
 - 4. Approved Equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Culverts other precast structures shall be constructed to the dimensions as shown in the Drawings and as specified in these Specifications.
- B. All precast installation shall be constructed in accordance the manufacturer's recommendations.
- B. The base shall be cast-in-place concrete (as specified in Division 3), placed on a thoroughly compacted gravel sub-base. The tops of the cast-in-place bases shall

be shaped to mate with the precast barrel section, and shall be adjusted in grade so that the top of the dome section is approximately at the correct elevation.

- C. Pre-cast apron, conforming to all requirements of (2.01 A) listed requirements for precast sections, may be used.
- E. Holes in the concrete sections required for handling, or other purposes, shall be plugged with a non-shrinking grout or by grout in combination with concrete plugs.
- F. Where holes may be cut in the precast sections to accommodate pipes, cutting shall be done prior to setting them in place to prevent any subsequent jarring which may loosen the mortar joints.
- G. Cast iron frames and covers shall be furnished and installed as per GDOT latest Standard Specifications unless otherwise noted on the Construction Plans.

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