

Brunswick - Glynn
Joint Water and Sewer Commission

TECHNICAL SPECIFICATIONS

FOR

EXIT 42 ELEVATED STORAGE TANK PROJECT
BRUNSWICK, GLYNN COUNTY, GEORGIA
JWSC PROJECT NO. 2213



PREPARED BY

BRUNSWICK-GLYNN JOINT WATER & SEWER COMMISSION
1703 GLOUCESTER STREET BRUNSWICK, GA 31520

TABLE OF CONTENTS

DIVISION 01 – GENERAL REQUIREMENTS

01 01 00 – Project Location and Site Access
01 11 00 – Summary of Work
01 11 05 – Measurement and Payment
01 11 80 – Environmental Conditions
01 12 16 – Work Sequence
01 14 19 – Use of site
01 31 19 – Project Meetings
01 32 16 – Construction Progress Schedule
01 32 33 – Photographic Documentation
01 33 00 – Submittal Procedures
01 35 43 – Environmental Procedures
01 35 53 – Security Procedures
01 40 00 – Quality Requirements
01 45 23 – Testing and Inspection Services
01 52 50 – Contractor's Facilities, Utilities, and Staging Areas
01 66 00 – Product Storage and Protection
01 71 33 – Protection and Maintenance of Property and Work
01 74 23 – Cleaning and Waste Management
01 75 00 – System Testing
01 77 00 – Closeout Procedures
01 78 23 – Operation and Maintenance Data
01 78 43 – Spare Parts and Maintenance Materials
01 78 36 – Warranties
01 78 39 – Project Record Documents
01 91 00 – Commissioning
01 99 90 – Reference Forms

DIVISION 02 – EXISTING CONDITIONS

02 32 00 – Geotechnical Investigation

DIVISION 03 - CONCRETE

03 11 00 – Concrete Forming
03 20 00 – Concrete Reinforcing
03 30 00 – Cast-In-Place Concrete

DIVISION 05 – METALS

05 15 13 – Zinc Coatings
05 05 20 – Anchor Bolts

DIVISION 09 – FINISHES

09 90 00 – Painting and Coating Systems

DIVISION 26 – ELECTRICAL

26 01 00 – Basic Electrical Requirements
26 05 00 – Common Work Result for Electrical

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

26 09 13 – Electrical Power Management System

DIVISION 31 – EARTHWORK

31 10 00 – Site Preparation

31 23 00 – Excavation and Fill

31 23 19 – Dewatering

31 25 00 – Erosion and Sedimentation Control

31 41 00 – Sheet piling, Shoring and Bracing

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 12 16 – Asphalt Paving

32 13 13 – Concrete Paving

32 31 13 – Chain Link Fences and Gates

32 92 00 – Grassing

DIVISION 33 – UTILITIES

33 16 19 – Composite Elevated Tank

DIVISION 40 – PROCESS INTEGRATION

40 05 06.16 – Piping Connections

40 05 06.33 – Piping Appurtenances

40 05 07 – Hangers and Supports for Piping

40 05 19 – Ductile Iron Piping

40 05 61.16 – Gate Valves

40 05 73.13 – Air Relief Valves

ATTACHMENTS

Terracon Geotechnical Engineering Investigation – Geotechnical Report

Terracon Geotechnical Engineering Investigation – ESA Report

United States Army Corp of Engineers – Wetlands Encroachment Letter

FAA Determination Letter

DIVISION 01

GENERAL REQUIREMENTS

01 01 00	Project Location and Site Access
01 11 00	Summary of Work
01 11 05	Measurement and Payment
01 11 80	Environmental Conditions
01 12 16	Work Sequence
01 14 19	Use of Site
01 31 19	Project Meetings
01 32 16	Construction Progress Schedule
01 32 33	Photographic Documentation
01 33 00	Submittal Procedures
01 35 43	Environmental Procedures
01 35 53	Security Procedures
01 40 00	Quality Requirements
01 45 23	Testing and Inspection Services
01 52 50	Contractor's Facilities, Utilities, and Staging Areas
01 66 00	Product Storage and Protection
01 71 33	Protection and Maintenance of Property and Work
01 74 23	Cleaning and Waste Management
01 75 00	System Testing
01 77 00	Closeout Procedures
01 78 23	Operation and Maintenance Date
01 78 43	Spare Parts and Maintenance Materials
01 78 36	Warranties
01 78 39	Project Record Documents
01 91 00	Commissioning
01 99 90	Reference Forms

SECTION 01 01 00
PROJECT LOCATION AND SITE ACCESS

PART 1 GENERAL

1.1 PROJECT LOCATION

- A. The work covered under this contract will be performed at the following locations:
 - 1. The site of the new 750,000-gallon elevated Storage Tank is located at 118 Cherokee Trail, Brunswick, Georgia 31525.

1.2 SITE ACCESS

- A. Access to the tank site shall be via Cherokee Trail Drive.
- B. The Contractor's personnel are required to park their vehicles in the approved or designated areas to be determined by the Owner.
- C. The Contractor shall be responsible for maintaining site security. The site shall be secured at the end of the construction work every day per the Owner's instructions. Refer to Spec Section 01 35 53 for additional security requirements.

1.3 ADJACENT PROPERTY OWNERS

- A. Work shall be conducted in a manner not to disrupt adjacent properties.

1.4 LIMITS OF CONSTRUCTION

- A. All work performed under this contract, including storage, staging, and parking areas, shall be restricted to the locations shown on the Drawings. All storage and staging shall be limited to the tank property unless otherwise approved by the Owner.

1.5 FLOODPLAIN AND FLOODWAY

- A. This project work is located outside of any floodplains (the FEMA flood map for the selected area is number 13127C0115H, effective 01/05/2018).

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

- A. The work covered by this contract consists of:
 - 1. A new 750,000-gallon North Mainland Exit 42 elevated water storage tank site improvements such as access drive, yard piping, fencing, lighting, and associated work as described in the contract documents.

1.2 DESCRIPTION OF OWNER'S PROJECT

- A. The work for this project shall include, but not be limited to, furnishing all labor, material, incidentals, supervision, and equipment to perform site work; construct structures; install piping; perform yard work; provide erosion and sedimentation control; install, test and startup equipment; install, test and startup electrical in accordance with the Contract Documents to provide a complete and operating facility.
- B. The major components of the work covered by this contract consists of:
 - 1. New 750,000-gallon elevated water storage tank.
 - 2. Access drive, gates, fence, lighting, etc.
 - 3. Associated electrical improvements and other systems.
 - 4. Associated earthwork, yard piping, grading, paving and other site improvements.
 - 5. Erosion and sedimentation control.
 - 6. Project record documents, including drawings, operations and maintenance manuals and other documents.

1.3 QUANTITIES AND SCOPE OF WORK

- A. For unit price components, the Owner reserves the right to alter the quantities and scope of work to be performed at any time when and as found necessary. The Contractor shall perform the work as altered, increased, or decreased. Payment for such increased or decreased quantities and scope shall be made in accordance with contract documents.

1.4 CONTRACTS

- A. The Owner shall award the contract for this Work to a single prime contractor. The contractor shall be solely responsible for the timely completion of the work and successful startup of the facility.

1.5 CONSTRUCTION DOCUMENT LANGUAGE

- A. Specifications are written mostly in imperative and streamlined form; this imperative language is directed to the Contractor. Additionally, the words "shall be" shall be included by inference where a colon (:) is used within sentences or phrases.

1.6 PROTECTION OF WORK, PROPERTY AND PERSONS

- A. The Contractor shall be responsible for the care of all Work until its completion and final acceptance; and the Contractor shall, at its own expense, replace damaged or lost material and repair damaged parts of the Work, or the same may be done by the Owner, and the Contractor and its sureties shall be liable, therefore.
- B. The Contractor shall make its own provisions for properly storing and protecting all material and equipment against theft, injury, or damage from any and all causes. Damaged material and equipment shall not be used in the Work.
- C. The Contractor shall take all risks from floods and casualties or for delays from such causes. The Contractor may, however, be allowed a reasonable extension of time on account of such delays, subject to the conditions herein before specified.
- D. The Contractor shall remove from the vicinity of the completed Work all plant, buildings, rubbish, unused material, concrete forms, sheeting or equipment belonging to the Contractor or used under its discretion during construction; and in the event of the Contractor's failure to do so, the same may be removed by the Owner at the expense of the Contractor, and the Contractor and its sureties shall be liable, therefore.
- E. The Contractor shall adopt all practical means to minimize interference to traffic and inconvenience, discomfort, or damage.
- F. The Contractor shall protect against damage, any piling, duct, or structures crossing trenching or encountered in the Work and shall be responsible for any damage done to such structures or damage therefrom. The Contractor shall support or replace any such structures without delay and without any additional compensation, to the entire satisfaction of the Owner.
- G. The Contractor shall be responsible for all damage to persons and property directly or indirectly caused by its operations, and under all circumstances the Contractor shall comply with the regulations of the Owner, and the laws and regulations of the State of Georgia, relative to safety of persons and property and the interruption of traffic and the convenience of the public within the respective jurisdiction, and the Contractor shall be solely responsible for any damages caused by failure to provide proper safety.
- H. The Contractor will be held responsible for and be required to make restitution, at its own expense, for all damage to persons or property caused by the Contractor or subcontractor, or the agents, or employees of either during the progress of the Work and until its final acceptance.

PART 2 PRODUCTS

- A. All materials used in the work, including equipment shall be new and unused.

PART 3 NOT USED

END OF SECTION

SECTION 01 11 05
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SUMMARY

- A. This section defines the Bid Items of Work listed on the Bid Form and how payment shall be determined. Payment shall be made for each Bid Item based on the description in this section.
- B. Bid Prices included on the Bid Form shall be full compensation for all materials, labor, equipment, tools, construction equipment and machinery, materials testing, heat, utilities, mobilization, demobilization, transportation, taxes, overhead, markup, incidentals, and services necessary for the execution and completion of the Work in the Contract Documents to be performed under this Contract. For the Work described, the allowance and unit price, actual used and complete in place quantities of each Bid Item shall be measured in the field and certified by the owner upon completion of construction in the manner set forth for each item in this and other sections of the Specifications. Payment for all items listed on the Bid Form will constitute full compensation for all Work shown and specified to be performed.
- C. The Contractor shall assist and fully cooperate with the owner to determine proper measurement and payment for each item providing complete and reasonable backup documentation as requested by the owner to substantiate payment due.
- D. Any item of work shown on the Contract Drawings or called for in the Specifications but not specifically enumerated for separate measurement and payment in the various project bid items, or which is incidental, shall be included in the various contract bid items as determined by the Contractor.
- E. Any and all work required to complete the Work called for in the Contract Documents shall be included in the various Bid Items whether or not such work is specifically called for. The individual Bid Item descriptions are not exhaustive and do not detail each specific item need to complete the Work of that Bid Item. Any necessary labor, materials, equipment, tools, appurtenances, or other items not mentioned but required to complete the Work shall be considered incidental to Contract, and as such, shall be included in the appropriate Bid Item prices.

1.2 NONPAYMENT FOR REJECTED OR UNUSED PRODUCT

- A. Payment will not be made for following:
 - 1. Loading, hauling, and disposing of rejected material.
 - 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
 - 3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
 - 4. Material not unloaded from transporting vehicle.
 - 5. Material and equipment not properly stored.

6. Defective Work not accepted by Owner.
7. Material remaining on hand after completion of Work.

1.3 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment:

1. No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Engineer.

B. Final Payment:

1. Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.4 BID ITEMS

- A. Bid Prices included on the Bid Form shall be full compensation for all materials, labor, equipment, tools, construction equipment and machinery, heat, utilities, transportation, taxes, overhead, markup, incidentals, and services necessary for the execution and completion of the Work in the Contract Documents to be performed under this Contract. For the Work described, the allowance and unit price, actual used and installed quantities of each bid item shall be measured in the field and certified by the Engineer and/or Owner upon completion of construction in the manner set forth for each item in this and other sections of the Specifications. Payment for all items listed on the Bid Form will constitute full compensation for all Work shown and specified to be performed.
- B. As detailed in the Bid Form, the contractor may bid on Item No. 1 - 3.
1. **Item No. 1: Site Work**
 - a. Measurement: The Lump Sum bid for providing all work included in the Contract Documents for the site work associated with the North Mainland Exit 42 750,000-Gallon CET water storage tank.
 - b. Payment: Contractor shall furnish all labor, material, incidentals, supervision, and equipment to perform all site work presented in the Contract Documents. Work including exterior piping, connection to existing watermain(s), testing, final grading, storm drainage system, fencing, access road improvements, asphalt and gravel drive and all other work and appurtenances.
 2. **Item No. 2: Tank Foundation**
 - a. Measurement: The Lump Sum bid for providing all work included in the Contract Documents for the tank foundation.
 - b. Payment: Contractor shall furnish all labor, material, incidentals, supervision, and equipment to perform all work presented in the Contract Documents for all labor necessary for constructing the tank foundation, complete including earth excavation, backfill, grading, testing and all other work and appurtenances.
 3. **Item No. 3: 750,000 Gallon Composite Elevated Storage Tank**
 - a. Measurement: The Lump Sum bid for providing all work included in the Contract Documents for the 750,000 gallon composite elevated storage tank.
 - b. Payment: Contractor shall furnish all labor, material, incidentals, supervision, and equipment to perform all work presented in the Contract Documents for the construction of a 750,000 gallon composite elevated storage tank including concrete support structure, steel tank (excluding the cost of site work in item 1 and cost of tank foundation in item 2), painting, electrical, interior piping, valves,

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

pipe supports, testing, and all other work and appurtenances necessary for the completion of work as shown in the drawings and/or contract documents.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 11 80
ENVIRONMENTAL
CONDITIONS

PART 1 GENERAL

1.1 ENVIRONMENTAL CONDITIONS

- A. This section describes the environmental conditions which have been observed at the site of the work and which may reasonably be anticipated throughout the life of the project.

1.2 CLIMATE CONDITIONS

- A. The site of the work is at an elevation of about 30 feet above mean sea level.
- B. Climate conditions are described as follows:

Description	Range of Conditions
Winter	Rain/Snow/Freeze
Summer	Mild/Warm/Hot
Relative humidity, percent <ul style="list-style-type: none">Average outdoors	72 to 78
Air temperature range, degrees F <ul style="list-style-type: none">Outdoors	40 to 95
Barometric pressure, inches, mercury	29.98 to 30.14

1.3 ADDITIONAL CONDITIONS

- A. Additional conditions which may be applicable are specified in other sections.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 12 16
WORK SEQUENCE

PART 1 GENERAL

1.4 CONTINUITY OF WATER DISTRIBUTION OPERATIONS

- A. The existing 12-inch water main the proposed tank will connect to is currently and continuously in use as part of the Brunswick-Glynn Joint Water & Sewer Commission's potable water distribution system. The existing water main operations and access to the tank site by the BGJWSC staff shall not be interrupted. The Contractor shall coordinate the work with the Owner to avoid any interference with normal operations and processes.

1.5 SUBMITTALS

- A. In accordance with Section 01 33 00, the Contractor shall submit a construction sequencing plan and detailed outage plan and time schedule for operations which will make it necessary to remove a tank, pipeline, channel, electrical circuit, equipment, or structure from service. The schedule shall be coordinated with the construction schedule specified in the General Conditions of the Contract Documents and shall meet the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's means and methods, the length of time required to complete said operation, and the necessary equipment.
- B. The Contractor shall observe the following restrictions:
 - 1. Systems or individual equipment items shall be isolated, dewatered, decommissioned, deenergized, or depressurized in accordance with the detailed outage plan and schedule.
 - 2. The Engineer and Owner shall be notified in writing at least two weeks in advance of the planned operation.

1.6 CONSTRUCTION SEQUENCING AND SCHEDULE CONSIDERATIONS

- A. Operation of the existing 12-inch water main shall continue.
- B. The final work sequence acceptability shall be at the discretion of the Owner.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 14 19
USE OF SITE

PART 1 GENERAL

1.1 SUMMARY

- A. The Owner's operating and maintenance personnel will be responsible for operating the existing water main throughout the execution of this contract.

If it is necessary in the course of operating / accessing the existing water main, for the Contractor to move his equipment, materials, or any material included in the work, he shall do so promptly and place that equipment or material in an area which does not interfere with the operation and maintenance. The Contractor shall schedule and conduct his work to minimize necessary shutdowns and interference with normal operations and maintenance. The Contractor shall not adjust or operate serviceable or functioning equipment or systems except as specifically required by this contract.

- B. The Contractor shall notify the Owner, in accordance with Section 01 12 16, 1 week in advance of the time it is necessary to take out of service any existing tank, pipeline, channel, electrical circuit, equipment or structure. The Owner's operating personnel will be responsible for operating any existing valves with prior notification and planning per Section 01 12 16. Any unnecessary additional cost to operations due to the contractor's poor workmanship or planning (repeat shut-downs or testing for example) shall be the responsibility of the contractor.
- C. The Contractor's work force shall not use the Owner's existing facilities, including telephones and power, or other facilities. The Contractor shall provide all such facilities for the use of his personnel as specified in Section 01 52 50.
- D. The contractor is responsible for security of their equipment and materials to be incorporated into the work.
- E. Any spill or disruption to the current operation and maintenance of the existing tank site caused by the contractor shall be the financial responsibility of the contractor.
- F. The contractor shall be responsible for any repair or replacement if damage to existing equipment or structures not slated for removal is caused by the contractor.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Construction period meetings will be conducted monthly or at some other frequency as determined by the Owner and Engineer. These meetings shall be attended by the Owner's representative, Engineer, and the Contractor's Project Manager with appropriate staff, subcontractors, or suppliers. Meetings shall include a pre-construction meeting, construction progress meetings, and other meetings called by the Owner or Engineer in response to developments during the work.
- B. Contractor and Subcontractor representatives attending meetings must be qualified and authorized to act on behalf of their firms.

1.2 PRECONSTRUCTION MEETING

- A. Owner will schedule a meeting to be held prior to the Contractor mobilizing and beginning any Work. This meeting is to review Construction Documents, administration requirements and mobilization procedures.
- B. Meeting Location: To be determined.
- C. Participants shall include:
 - 1. Contractor's Project Manager, Superintendent, CQC Representative, Safety and Health Officer
 - 2. Owner
 - 3. Engineer
 - 4. Owner's Maintenance and Operation Staff, as appropriate
 - 5. Others, including major Subcontractors, as appropriate.
- D. Engineer will:
 - 1. Administer the meeting.
 - 2. Record and distribute copies of minutes within seven days of meeting to all meeting participants.
- E. Agenda: Discussion will pertain to detailed information, such as:
 - 1. The Work – including, but not limited to:
 - a. Scheduling and phasing requirements
 - b. Contractor's use of premises
 - c. Special conditions and coordination
 - d. Security
 - 2. Communications – including, but not limited to:
 - a. Change and persons authorized to direct changes

- b. Requests for Information (RFI), field decisions, and clarifications
 - c. Non-Conformance Reports
 - d. Hazard communication
 - e. Project meetings
 - 3. Contractor's Site-Specific Safety Plan
 - 4. Administrative and procedural requirements including, but not limited to:
 - a. Contract modification
 - b. Progress payment
 - c. Submittals - including Contractor's Construction Progress Schedule
 - d. Electronic Communications
 - e. Apprentice and Journey Level Worker Utilization Reporting, if required
 - 5. Owner/Third Party testing and inspection
 - 6. Contractor Quality Control
 - 7. Temporary Facilities and Controls including, but not limited to:
 - a. Deliveries and storage
 - b. Temporary utilities and enclosures
 - c. Security procedures
 - d. Noise and vibration control
 - e. Cutting, patching, and field engineering
 - f. Utility shutdowns
 - g. Contractor parking
 - h. Housekeeping and waste management
 - 8. Closeout Procedures – including Project Record documents.
- F. Contractor shall conduct a like meeting, covering the same body of information, with each Subcontractor's project manager and foreman supervising the Work prior to the performance of any work on site by that Subcontractor.
- 1. Provide Engineer copies of meeting minutes prepared by the Contractor with each Subcontractor, when requested by Engineer.

1.3 CONSTRUCTION PROGRESS MEETINGS

- A. Frequency: Biweekly or at other intervals as appropriate throughout the duration of construction.
- B. Meeting Location: Field office, or as mutually agreed.
- C. Participants shall include:
 - 1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer as appropriate
 - 2. Owner
 - 3. Engineer

4. Owner's Operation and Maintenance Staff, as appropriate
 5. Others, as appropriate
- D. Contractor shall:
1. Administer the meetings.
 2. Provide schedules, logs and other construction activity data in support of the issues discussed and recorded in meeting minutes.
 3. Record and distribute copies of minutes prior to the next meeting.
- E. Engineer will:
1. Will review meeting minutes and ascertain that the Work is in accordance with the Construction Documents and the Construction Progress Schedule.
- F. Agenda: Discussion will pertain to items, such as:
1. Review and approve minutes of previous meeting noting exceptions, if any
 2. Review Work progress since previous meeting
 3. Review plans for progress during subsequent work period
 - a. Identify pending meetings.
 - b. Discuss safety activities and Job Hazards Analysis
 4. Discuss field observations, problems, and conflicts.
 - a. Identify problems impeding the Construction Progress Schedule
 5. Review Quality Control
 - a. Non-conformance reports - discuss corrective Work actions.
 6. Review Submittal Schedules and RFIs - present methods to expedite as required.
 7. Review off-site fabrication and delivery schedules.
 8. Review proposed changes in the Work and substitution requests for:
 - a. Timely processing
 - b. Effect on Construction Progress Schedule and on completion date
 - c. Effect on any other contracts of the Project

1.4 CHANGE ORDER MEETINGS

- A. Change Order meetings shall be held to review and resolve any change order proposals, change order requests, or other change order issues pertaining to Contract Modification. Meetings shall be held bi-weekly, or as needed until all Change Order Proposals are resolved.
- B. Meeting Location: To be determined.
- C. Participants shall include:
1. Contractor's Project Manager or cost estimator, as appropriate
 2. Owner
 3. Engineer
 4. Others, as appropriate.

- D. Contractor shall:
 - 1. Record and distribute copies of minutes within seven days.
- E. Owner will:
 - 1. Administer the meeting.
- F. Agenda: discussion will pertain to items such as:
 - 1. Review of Change Order Proposals, scope, estimated costs
 - 2. Negotiation of prices for Change Order Proposals.

1.5 MONTHLY PROGRESS SCHEDULE UPDATE MEETINGS

- A. In accordance with Section 01 32 16.

1.6 COMMISSIONING MEETINGS

- A. Commissioning meetings shall occur weekly during the facility start-up and commissioning phase of the Work.
- B. Meeting Locations: To be determined.
- C. Participants shall include:
 - 1. Contractor's Startup Manager, as Specified in Section 01 75 00, and Superintendent as appropriate.
 - 2. Subcontractor(s) representative(s), as appropriate
 - 3. Owner
 - 4. Engineer
 - 5. Owner's Maintenance and Operation Staff, as appropriate
 - 6. Others, as appropriate.
- D. The Contractor shall:
 - 1. Record and distribute copies of minutes prior to the next meeting.
- E. The Engineer will:
 - 1. Administer the meeting.
 - 2. Ascertain that the Project commissioning processes, and information provided is in accordance with the Construction Documents.
- F. Agenda: Discussion will pertain to items such as:
 - 1. Coordination of Work of applicable trades, e.g., balancing, electrical, controls, communications wiring connectivity
 - 2. Scheduling of systems shut down(s) and switch over(s)
 - 3. Start-up and functional performance tests acceptance criteria
 - 4. Code and ordinance inspections/approvals.

1.7 SPECIAL MEETINGS

- A. Special meetings may be called at the discretion of the Owner, Engineer, or Contractor for the purpose of coordinating specific information or resolving special issues.
- B. Meeting Location: Engineer's field office, unless otherwise agreed.
- C. Contractor shall record minutes and distribute copies within three days.

1.8 POST CONSTRUCTION WARRANTY MEETING

- A. Meet with the Owner approximately 11 months after the date of Final Completion to inspect the Work and to prepare punch list of warranty items requiring appropriate manufacturers and subcontractors.

1.9 OTHER MEETINGS

- A. Other meetings may be called by Owner or Engineer, as warranted by unforeseen developments during construction. All interested parties shall attend such called other meetings.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SCOPE

- A. This section specifies the procedures for preparing and revising the critical path method construction schedule used for planning and managing construction activities. The schedule provides a basis for determining the progress status of the project relative to specific dates and completion time.

1.2 DESCRIPTION

- A. The Contractor shall provide a graphic construction schedule prepared by the critical path method of analysis. The critical path schedule shall be prepared from estimates of the required duration and sequence for each item of work and function to be performed. A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, A Manual for Contractors," published by the Associated General Contractors of America. Tabulation and analysis of the work schedule shall be performed by computer using a commercially available critical path software program. In addition to the capability to produce tabular reports, the computer software shall plot the construction schedule after the Contractor has produced it in a draft form as required by paragraph 1.03 Submittal Procedures.
- B. The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor in accordance with the General Conditions of the Contract Documents. The dependencies between activities shall be indicated so that it may be established what effect the progress of any one activity has on the schedule.
- C. Time for completion and all specific dates as specified in the Contract Documents and sequencing requirements described in Section 01 12 16 shall be shown on the schedule. Activities making up the critical path shall be identified.
- D. No activity on the schedule shall have a duration longer than 21 days or assigned value greater than \$100,000, except activities comprising only fabrication, and delivery may extend for more than 21 days. Activities which exceed these limits shall be divided into more detailed components. The schedule duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

1.3 SUBMITTAL PROCEDURES

- A. Within 20 days after the date of Notice to Proceed, the Contractor shall complete a construction schedule conforming to paragraph 1.02 Description and representing in detail all planned procurement and on-site construction activities. The Contractor shall submit the schedule to the Engineer in accordance with Section 01 33 00.
- B. Within 7 days after receipt of the submittal, the Engineer shall review the submitted schedule and return one copy of the marked-up original to the Contractor. If the Engineer

finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy, returned to the Contractor for corrections and resubmitted as specified in Section 01 33 00.

1.4 SCHEDULE REVISIONS

- A. Revisions to the accepted critical path construction schedule may be made only with written approval of the Contractor and Owner. Changes in timing for activities which are not on the critical path may be modified with written agreement of the Contractor and Engineer. A change affecting the contract value of any activity, the timing of any activity on the critical path, the completion time and specific dates as specified in the Contract Documents, and work sequencing (Section 01 12 16) may be made only in accordance with applicable provisions of the General Conditions of the Contract Documents.

1.5 PROJECT STATUS UPDATE

- A. Project status review and update shall be provided each month as specified in the General Conditions of the Contract Documents.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.1 PRECONSTRUCTION PHOTOGRAPHS AND VIDEO

- A. The Contractor shall provide preconstruction photographs and video prior to commencement of work on the site.
- B. The documentation shall be digital, and shall indicate the date, name of project, direction in which the images were taken and the location where the images were taken.
- C. A minimum of 50 photographs shall be taken prior to construction, along with a video of property / potential disturbed areas.
- D. Before construction may start, digital copies of the documentation shall be delivered on a CD/DVD/USB to the Engineer and Owner.
- E. The Contractor shall document the entire area of proposed construction and site entries and access roads from multiple perspectives.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUBMITTALS

- A. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical, and electronic equipment and systems, materials, reinforcing steel, fabricated items, and piping and conduit details. The Contractor shall furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specifically required in the contract documents to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

1.2 CONTRACTOR'S RESPONSIBILITIES

- A. General:
1. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment, or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment, which are being submitted for review. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work of another contractor or the Owner. The Contractor shall coordinate submittals among his subcontractors and suppliers including those submittals complying with unit responsibility requirements as specified in applicable technical sections.
 2. The Contractor shall coordinate submittals with the work so that work will not be delayed. He shall coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals. The Contractor shall not proceed with work related to a submittal until the submittal process is complete. This requires that submittals for review and comment shall be returned to the Contractor stamped "No Exceptions Taken" or "Make Corrections Noted."
 3. The Contractor shall certify on each submittal document that he has reviewed the submittal, verified field conditions, and complied with the contract documents.
 4. The Contractor may authorize in writing a material or equipment supplier to deal directly with the Engineer or with the Owner with regard to a submittal. These dealings shall be limited to contract interpretations to clarify and expedite the work.

1.3 CATEGORIES OF SUBMITTALS

A. General:

1. Submittals fall into two general categories; submittals for review and comment, and submittals which are primarily for information only. Submittals which are for information only are generally specified as Product Data in Part 2 of applicable specification sections.

B. Submittals for review and comment:

1. All submittals except where specified to be submitted as product data for information only shall be submitted by the Contractor to the Engineer for review and comment.

C. Submittals (product data) for information only:

1. Where specified, the Contractor shall furnish submittals (product data) to the Engineer for Information only. Submittal requirements for operation and maintenance manuals, which are included in this category, are specified in Section 01 78 23.

1.4 TRANSMITTAL PROCEDURE

A. General:

1. Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Transmittal Form 01 33 00-A specified in Section 01 99 90. Submittals for operation and maintenance manuals, information and data shall be accompanied by Transmittal Form 01 78 23-A specified in Section 01 99 90. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
2. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: XX XX XX.XX.YY, where 'X' denotes the applicable specification section and 'Y' denotes the individual submittal number for that particular specification section, beginning with 01. The initial submittal shall be identified as "Revision" 000. Subsequent resubmittals shall be identified 001, 002, etc. Packages shall be identified as follows: XXXXXXXXAA; where 'X' denotes the applicable specification.

B. Check Marked Specification Transmittal Procedures

1. When submittal requirements require a "marked" copy of the specification, provide a copy of the specification marked as indicated below. Provide the following when transmitting the submittal:
 - a. Provide a copy of the specification section(s) that specifies a marked copy of the specification. Include addendum updates and referenced specification sections, with addendum updates. Complete the following:

- 1) Check-mark each paragraph to indicate submittal compliance with that specification requirement. Check marks (✓) shall denote full compliance with that paragraph as a whole.
 - 2) Mark paragraphs where deviations are proposed by underlining text that is the subject of the proposed deviation. Denoting each proposed deviation with a number in the margin to the right of the identified paragraph and provide a detailed written explanation for each numbered deviation. The remaining portions of the paragraph not underlined signify compliance with specified requirements.
 - 3) The Engineer is the final authority for determining acceptability of requested deviations.
- b. For equipment specifications, provide a copy of the control diagrams and process and instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the subject equipment. Complete the following:
- 1) Mark drawings or diagrams to show specific changes necessary for the equipment proposed in the submittal.
 - 2) If no changes are required, mark the drawings or diagrams with "no changes required".
- C. Provide a Certificate of Unit Responsibility assigning unit responsibility in accordance with the requirements of the specification Section. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with the Specifications.

Samples and Mock

- D. Deviation from contract:
1. If the Contractor proposes to provide material, equipment, or method of work which deviates from the project manual, he shall indicate so under "deviations" on the transmittal form accompanying the submittal copies.
- E. Submittal completeness:
1. Submittals which do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.
- F. Submittal schedule and log:
1. Contractor shall prepare and maintain a submittal log/schedule that includes all specified submittals for the project. Copies of the submittal log shall be provided to the Owner and Engineer for review within 15 days of the notice to proceed. No progress payments will be made by the Owner until the submittal log/schedule is accepted and approved by the Engineer.
 2. The schedule shall clearly delineate submittals for review and comment and product data (submittals) for information only.
 3. Submittal schedule information shall be updated monthly with the Contractor's updated project schedule.
 4. The Contractor shall identify as an activity in the project schedule specified in Section 01 32 16, all major equipment submittals as well as those involving complex reviews and long lead deliveries.

1.5 REVIEW PROCEDURE

A. General:

1. Submittals are specified for those features and characteristics of materials, equipment, and methods of operation which can be selected based on the Contractor's judgment of their conformance to the specified requirements. Other features and characteristics are specified in a manner which enables the Contractor to determine acceptable options without submittals. The review procedure is based on the Contractor's guarantee that all features and characteristics not requiring submittals conform as specified. Review shall not extend to means, methods, techniques, sequences, or procedures of construction, or to verifying quantities, dimensions, weights or gages, or fabrication processes (except where specifically indicated or required by the project manual) or to safety precautions or programs incident thereto. Review of a separate item, as such, will not indicate approval of the assembly in which the item functions.
2. When the contract documents require a submittal, the Contractor shall submit the specified information as follows:
 - a. Three (3) hard copies of all submitted information plus one digital pdf copy of all information shall be transmitted with submittals for review and comment.
 - b. Unless otherwise specified, 3 copies of all sample data shall be transmitted with submittals (Product Data) for information only.

B. Submittals for review and comment:

1. Unless otherwise specified, within 30 calendar days after receipt of a submittal for review and comment, the Engineer shall review the submittal and return 1 copy of the marked-up copy. The marked-up copy /returned submittal will be retained by the Engineer. The returned submittal shall indicate one of the following actions:
 - a. If the review indicates that the material, equipment, or work method complies with the project manual, submittal copies will be marked "NO EXCEPTIONS TAKEN." In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
 - b. If the review indicates limited corrections are required, copies will be marked "MAKE CORRECTIONS NOTED." The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O&M data, a corrected copy shall be provided.
 - c. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "AMEND AND RESUBMIT." Except at his own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
 - d. If the review indicates that the material, equipment, or work method does not comply with the project manual, copies of the submittal will be marked "REJECTED - SEE REMARKS." Submittals with deviations which have not been identified clearly may be rejected. Except at his own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

- C. Submittals (product data) for information only:
 - 1. Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.

1.6 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

- A. General:
 - 1. Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer or the Owner, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Owner has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.
- B. total contract value of the work.
- C. The report is to be submitted in both printed and electronic format. Electronic format shall be provided on CD/USB.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 35 43
ENVIRONMENTAL PROCEDURES

PART 1 GENERAL

1.1 SITE MAINTENANCE

- A. The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary.
- B. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

1.2 TEMPORARY DAMS

- A. Except in time of emergency, earth dams are not acceptable at catch basin openings, local depressions, or elsewhere. Temporary dams of sandbags, asphaltic concrete, or other acceptable material will be permitted when necessary to protect the work, provided their use does not create a hazard or nuisance to the public. Such dams shall be removed from the site as soon as they are no longer necessary.

1.3 AIR POLLUTION CONTROL

- A. The Contractor shall not discharge smoke, dust, and other contaminants, into the atmosphere that violate the regulations of any legally constituted authority. He shall also abate dust nuisance by cleaning, sweeping, and sprinkling with water, or other means as necessary. The use of water, in amounts that result in mud on public streets, is not acceptable as a substitute for sweeping or other methods. The Contractor shall provide dust control at no additional cost to the Owner.

1.4 NOISE CONTROL

- A. Between 7:30 p.m. and 7:00 a.m., noise from Contractor's operations shall not exceed limits established by applicable laws or regulations and in no event shall exceed 86 dBA at a distance of 50 feet from the noise source.

1.5 SEDIMENTATION AND EROSION CONTROL

- A. Contractor shall employ best management practices in accordance with Local, State and Federal guidelines and regulations for erosion and sedimentation control. Unless otherwise noted, Contractor shall obtain related permits or approvals and pay applicable fees.

1.6 STATE OR FEDERAL WATERS

- A. State or Federal Waters, wetlands or other environmental features shall not be disturbed without proper approvals, permits or notifications, which are the responsibility of the Contractor.

1.7 HAZARDOUS MATERIALS STORAGE

- A. The Contractor shall submit Material Safety Data Sheets (MSDSs) for all hazardous chemicals contained onsite to the Engineer. The Contractor shall also maintain a copy of all applicable MSDSs onsite at all times.
- B. The Contractor shall notify the Owner and the Engineer upon receipt of any hazardous chemicals onsite.
- C. All hazardous chemicals onsite must be placed in approved containment with an appropriate leak detection system. Flammable materials (i.e., paints, thinners, solvents, etc.) must be stored in approved fire storage cabinets.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 53
SECURITY PROCEDURES

PART 1 GENERAL

1.1 GENERAL

- A. The water tank site is not considered to be secure. Contractor shall provide any and all required security required to protect its equipment and materials.

1.2 SECURITY PROGRAM

- A. The Contractor shall execute a security program to protect the Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry. Contractor shall maintain the program throughout construction period until Owner occupancy.

1.3 TEMPORARY FENCES

- A. Except as otherwise provided, the Contractor shall enclose the site of the Work with a fence adequate to protect the Work and temporary facilities against acts of theft, violence, or vandalism.
- B. In the event all or a part of the site is to be permanently fenced, this permanent fence or a portion thereof may be built to serve for protection of the Work site, provided however, that any portions damaged or defaced shall be replaced prior to final acceptance.
- C. Temporary openings in existing fences shall be protected to prevent intrusion by unauthorized persons. During night hours, weekends, holidays, and other times when no Work is performed at the site, the Contractor shall provide temporary closures or guard service to protect such openings. Temporary openings shall be fenced when no longer necessary.

1.4 ENTRY CONTROL

- A. The Contractor shall at all times monitor and control access of persons to the Project Site. Specifically, Contractor shall:
 - 1. Restrict entrance of persons and vehicles into Project site.
 - 2. Allow entrance only to authorized persons with proper identification.
 - 3. Maintain log of workmen and visitors, make available to Owner on request.
 - 4. Contractor shall control entrance of non-authorized persons and vehicles. Owner shall be allowed access to Project Site for work associated with operations and maintenance.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section specifies administrative and procedural requirements for quality control services, field inspections and field testing of civil and structural constructs required for this project. Contractor is responsible for the quality assurance and quality control of their respective work.

1.2 DEFINITIONS

- A. Quality Control System (QCS): The quality control, assurance, and inspection system established and carried out to ensure compliance with the Plans and Specifications.
- B. QCS Supervisor: That person in responsible charge of the work occurring, as designated by the Contractor in the QCS Plan.
- C. QCS Inspector: Responsible, certified personnel inspecting the various constructs at specified milestones and during the project overall and designated by the Engineer. The Special Inspector is part of the QCS Inspector team.
- D. Factory Test: Tests made on various materials, products, and component parts prior to shipment to the job site.
- E. Field Tests: Tests and analyses made at or in the vicinity of the job site in connection with the actual construction.
- F. Certified Inspection Report: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report
- G. Certificate of Compliance: Certificate from the manufacturer of the material or equipment identifying said manufacturer, product and referenced standard, and shall be signed by a designated officer of the manufacturer.
- H. Standard Compliance: Condition whereby specified materials or equipment must conform to the standards of organizations such as the American National Standard Institute (ANSI), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL) or similar organization.
- I. Quality Assurance: The day-to-day, in-process supervisory observations of work and materials conducted by the Contractor to assure that the proper methods and materials are being used and installed by tradesmen.
- J. Source Quality Control: The in-process testing and inspections conducted by the QCS Inspector(s) to verify that the materials, equipment, workmanship and shop manufactured constructs are in compliance with the Contract Documents, applicable Codes and standards.

- K. Field Quality Control: The testing and inspections conducted by the QCS Inspector(s) in the field during and at the completion of each construct to verify that the in-process and completed construction is in compliance with the Contract Documents, applicable Codes and standards.

1.3 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ASTM C102	Practice for Laboratories Engaged in the Testing of Building Sealants.
ASTM C802	Practice for Conducting an Inter-Laboratory Test Program to Determine the Precision of Test Methods for Construction.
ASTM C1093	Practice for Accreditation of Testing Agencies for Unit Masonry.
ASTM D3740	Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
ASTM D4561	Practice for Quality Control Systems for an Inspection and testing Agency for Bituminous Paving Materials.
ASTM E329	Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction.
IBC	2003 International Building Code, locally amended

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Monitor quality assurance over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Coordinate with, schedule specified inspections by, and provide normal and customary assistance to the QCS Inspectors.
- C. Comply fully with manufacturers' instructions, including each step in sequence.
- D. Should manufacturers' instructions conflict with Contract Documents, request clarification before proceeding from Engineer.

- E. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- F. Perform work by persons qualified to produce workmanship of specified quality.

1.5 REGULATORY REQUIREMENTS

A. General:

- 1. Comply with all Federal, State, and local Codes as referenced herein. Such regulations apply to activities including, but not limited to, sitework and zoning, building practices and quality, on and offsite disposal, safety, sanitation, nuisance, and environmental quality.

B. Special Inspection:

- 1. Special Inspection shall be performed by the Special Inspector under contract with the Owner in conformance with the IBC. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

C. Structural Observation:

- 1. Engineer shall make visual inspections of the work to assess general conformance with the Contract Documents at significant construction stages and at completion of the structural system. The QCS shall include a preliminary set of Structural Observations and what items are expected to be observed. Contractor shall request this preliminary set from Owner through Engineer and submit as part of their QCS submittal.
- 2. The following structural milestones shall be considered significant construction stages:
 - a. Structure fill and deep foundations including piling.
 - b. Foundations prepared for concrete placement, including grade beams, pile caps, strip, mat and pad footings, and monolithic slabs on grade.
 - c. Preparation of concrete, water-retaining walls prior to placement of concrete.
 - d. Completion of bearing walls prior to cover-up with nonstructural elements, including concrete, masonry, cold formed steel, and lumber.
 - e. Roof and floor framing, including framed and sheathed systems, slabs, and composite systems.
 - f. Completion of lateral force resisting system elements not included in the above categories including moment connections, bracing, diaphragms, or other.
 - g. Completion of structural system after all significant architectural, mechanical, plumbing, heating/ventilation equipment, electrical, and finish elements are installed.

1.6 FIELD SAMPLE PROCEDURES

- A. When field samples are specified in a unit of work, construct each field sample to include work of all trades required to complete the field sample prior to starting related field work. Field samples may be incorporated into the project after acceptance by Engineer.

Remove unacceptable field samples when directed by Engineer. Acceptable samples represent a quality level for the work.

1.7 CONTRACTOR DESIGNED STRUCTURAL SYSTEMS

A. Design Engineering:

1. Contractor shall employ and pay for engineering services from a Professional Engineer registered in the State of Georgia for structural design of Contractor designed structural systems including but not limited to temporary shoring and bracing, formwork support, interior structural wall and ceiling systems, and support systems for fire sprinkler, plumbing, mechanical, and electrical systems and equipment.

B. Tests and Inspections of Contractor Designed Structural Systems:

1. Contractor shall pay for preliminary testing of concrete, grout, and mortar mix designs where required by Code or the submittal process prior to start of such work. Contractor shall pay for required shop and site inspection of Contractor designed structural systems where required by Code or these specifications, to the extent such testing and inspection exceeds that required for the structural system on the drawings and in these specifications.

1.8 MANUFACTURERS' FIELD SERVICES AND REPORTS

- A. When specified in individual specification sections, product suppliers or manufacturers shall provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment as applicable, and to provide instructions when necessary. Contractor shall submit qualifications of observer to Engineer 30 days in advance of required observations. QCS Inspector shall record observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

1.9 JOB SITE CONDITIONS

- A. Schedule to ensure all preparatory work has been accomplished prior to proceeding with current work. Proceeding with the work constitutes acceptance of conditions. Allow adequate time for materials susceptible to temperature and humidity to "stabilize" prior to installation. Establish and maintain environmental conditions (i.e., temperature, humidity, lighting) as recommended by the various material manufacturers for the duration of the work.

1.10 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
 1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability

of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

2. Written description of Contractor's proposed QCS plan in sufficient detail to illustrate understanding and approach. The QCS plan and submittal shall include a log showing anticipated inspections, Special Inspections, and source and field Quality Assurance procedures. Preliminary submittal of the QCS plan may be made prior to commencing field work. The preliminary submittal will illustrate the project's initial three (3) month's work and be followed one month later by a final QCS plan submittal.
3. Contractor's proposed QCS Supervisor, qualifications, and if requested, references.
4. Preliminary structural observation set as described in paragraph 1.05 Structural Observation.
5. Complete structural system information describing Contractor designed structural systems, including sealed calculations, shop and erection drawings, product literature for the various components, ICBO Evaluation Reports for structural components, and a discussion of risk issues associated with the proposed system which could adversely impact overall project completion.
6. If requested by the Engineer during the work, manufacturer's field services and reports. If not so requested, treat same as Product Data.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Contractor Responsibilities:

1. Provide source quality control according to the reviewed and accepted QCS plan and paragraph 1.04 herein. Coordinate with Engineer to facilitate the work of the Testing Laboratory specified in Section 01 45 23 and Special Inspector. Provide ready access to sampling and inspection locations and incidental labor customary in such sampling and inspections. Timely prepare and submit submittals and revise as indicated by review comments. Comply with technical requirements in each specification Section that applies to the work.

B. Engineer Responsibilities:

1. Review Contractor's tracking of QCS activities at monthly meetings. Facilitate completion of submittal review per Section 01 33 00. Assist Contractor to ensure that Special Inspection occurs where and when specified.

C. Acceptance Criteria:

1. Acceptable characteristics and quality of a particular item or construct is defined in that item's or construct's specification Section.

2.2 PRODUCT DATA

- A. The following product data shall be provided in accordance with Section 01 33 00.
 - 1. Manufacturers' field services and reports unless requested by Engineer to be submitted for review.
 - 2. Special Inspection reports, unless otherwise directed in each technical specification Section.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Field quality control responsibilities of the Contractor and Engineer are substantially the same as described in paragraph 2.1, with the exception that this work occurs primarily on the jobsite as the work progresses, and Special Inspection will occur more often than at the source.
- B. Acceptable characteristics and quality of a particular item or construct is defined in that item's or construct's specification Section.

3.2 REGULATORY COMPLIANCE – SPECIAL INSPECTIONS

- A. The following types of work require Special Inspection according to Chapter 17 of the IBC and each system's specification Section:
 - 1. Structure Fill.
 - 2. Deep foundations including piling.
 - 3. Structural concrete and reinforcing.
 - 4. Anchor bolts and post-installed anchor systems.
 - 5. Masonry systems, complete.
 - 6. Structural steel and aluminum including connections.
 - 7. Cold formed structural steel including connections.
 - 8. Steel deck and wood sheathing.
 - 9. Structural lumber including sawn and manufactured including connections.
 - 10. All components of the lateral force resisting system not included in the above.
- B. Section 01 45 23 describes Testing Laboratory sampling, testing, and reporting, much of which is conforming to Special Inspection requirements, and need not be replicated.
- C. Contractor designed structural systems are subject to the same Special Inspection requirements as all other work.

3.3 CORRECTION OF DEFECTIVE WORK

- A. Remove and replace defective, rejected, and condemned work at Contractor's expense until such work meets the requirements of Contract Documents.

END OF SECTION

SECTION 01 45 23
TESTING AND INSPECTION SERVICES

PART 1 GENERAL

1.1 SUMMARY

- A. General Requirements: Comply with the testing and inspection and correction of nonconforming work provisions herein specified in this Section and elsewhere in the Construction Documents.
- B. The Contractor will select and employ an independent Testing Agency to conduct the tests and inspections in accordance with applicable standard methods of American Society for Testing and Materials (ASTM) or other standards specified by the local governing authorities having jurisdiction (AHJ) as a requirement of the building permit.
- C. The Owner may require other special inspection services to inspect and verify the Work installed is in accordance with the Construction Documents and construction industry standards.
- D. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer, e.g., testing of pipe.

1.2 DESCRIPTION

- A. Definition: For the purpose of this section, all references made herein to Testing Agency or special inspector or geotechnical consulting firm shall be referred to as those tests or inspections which will be conducted by an inspector provided by the Engineer under contract to the Contractor.

1.3 QUALITY ASSURANCE

- A. Qualifications: The inspector for all Work as hereinafter specified, except for geotechnical inspections, waterproofing and roofing, shall be a registered special inspector employed by a state approved inspection and/or Testing Agency. All inspection personnel used on this Project are subject to being disapproved from the Project at the discretion of the Owner. Minimum levels of qualifications as required by the State of Georgia for various portions of the required inspections and testing must be complied with.
 - 1. The special inspector for waterproofing and roofing shall have the required technical knowledge and experience for the product being installed.
 - 2. Geotechnical inspection will be performed by a licensed geotechnical consulting firm.

1.4 DUTIES OF CONTRACTOR'S TESTING AGENCY

- A. General: The Contractor's Testing Agency will conduct testing and inspection services, interpret them, and evaluate the results for compliance with the building permit, the site development permit, and the Construction Documents; agency will report findings to the Owner, Engineer Contractor, and AHJ. Testing and inspection services shall be in accordance with applicable standard methods of ASTM or other standards specified by AHJ, the Construction Documents, and construction industry standards. The Testing Agency will reasonably support overtime, second shift, and out-of-area activity if

requested by the Contractor and approved at the Owner's sole discretion.

- B. Testing and Inspection: Materials to be tested are specified by the building permit and as required by the Construction Documents, as directed by Owner, or required by AHJ. Quantities and extent of tests and inspections shall be as specified and/or required by the Owner's Inspector or AHJ.
- C. Non-Conforming Work: The Owner's Inspector shall document and immediately notify the Contractor and Owner of any Work found defective or not in accordance with the requirements of the Construction Documents. Non-conforming Work shall be corrected or otherwise satisfactorily accepted by the Owner. See the Supplemental General Conditions.
- D. The Owner's Inspectors are not authorized to do the following:
 - 1. Release, revoke, alter or enlarge on requirements of Construction Documents.
 - 2. Approve or accept any portion of the Work, except as allowed by the special inspection duties delegated by governing AHJ for building permit inspections and testing.
 - 3. Perform any duties of the Contractor.
- E. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the Contractor's Inspectors or the Engineer.

1.5 COSTS

- A. The Contractor's Testing Agency and special Inspector costs for initial testing and inspection as specified in the Construction Documents will be paid for by the Contractor out of the materials testing allowance in the contract. Initial tests and inspections are defined as those required to complete the first tests and inspections specified.
- B. Additional tests and inspections not herein specified but requested by the Owner shall be paid for by the Contractor. However, if the results of such tests or inspections are found to be not in compliance with Construction Documents, the Contractor will be back charged for all costs for initial testing as well as re-testing, re-inspection, and Engineer's services.
- C. Costs for additional tests or inspections required because of Contractor changes to reviewed and accepted products or materials provided, or source, or supply shall be borne by the Contractor.
- D. Costs for any Work which is required to correct any deficiencies shall be borne by the Contractor.
- E. Costs of any testing which is required solely for the convenience of Contractor in its scheduling and performance of the Work shall be borne by the Contractor.
- F. Costs for verification testing of Work done without prior notice, with improper supervision, or contrary to construction practice shall be borne by the Contractor.
- G. Costs for testing of materials for which fabrication and mill reports are required but not furnished shall be borne by the Contractor.

- H. Standby costs due to the failure of the Contractor or their suppliers to be ready for the testing procedure so scheduled by the Contractor shall be borne by the Contractor.
- I. Any cost incurred by section 1.07 items J-L below should be paid for by the contractor.

1.6 TESTS AND INSPECTION REPORTS

- A. Copies of Owner and Contractor test and inspection reports shall be distributed at weekly intervals. All reports will be signed by an authorized representative of the Testing Agency or Professional Engineer registered in the State of Georgia, as appropriate. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations that are required shall also be reported. Test and inspection reports shall be electronically posted and distributed, with Testing Agency reports by the Owner and Contractor. Contractor shall be responsible for providing copies of reports as required to the Authority Having Jurisdiction.

1.7 CONTRACTOR'S RESPONSIBILITIES

- A. Coordination:
 - 1. It is the Contractor's responsibility to initiate, coordinate, and conform to the required tests and inspections of governing State and AHJ. Inspection of the Work by the Owner's special Inspectors and/or Testing Agency shall not relieve the Contractor from responsibility for compliance with the Construction Documents' requirements. Owner's special Inspectors and/or Testing Agency and Owner shall have authority to reject Work whenever the provisions of the Construction Documents are not being complied with, and the Contractor shall instruct his employees accordingly.
 - 2. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.
- B. Access for the Purpose of Inspection: Ensure the Owner's special Inspectors and/or Testing Agency have free access to all parts of the Work and to the shops where the Work is in preparation; are provided proper facilities and safe access for such inspection, and; are reasonably furnished access, equipment, tools, samples, certifications, test reports, design mixes, storage, and assistance as requested by the Owner's Inspector
- C. Storage Facilities: Furnish adequate storage facilities as approved by the Owner for the sole use of the Owner's Testing Agency for safe storage and curing of such specimens which must remain on the site prior to transport to the laboratory.
- D. Data: Furnish records, Contract Drawings and shop drawings, certificates, approved Change Orders, and similar data as required by Owner's Inspectors to perform their work to assure compliance with the Construction Documents.
- E. Notice: Furnish notice to Owner and coordinate with Owner's Inspectors a minimum of five (5) working days in advance of all required tests and a minimum of forty-eight (48) hours in advance of all required inspections, unless otherwise specified.
- F. Non-Conforming Work: Remove and replace Non-conforming Work at no additional cost to the Owner prior to Final Completion. Where Non-conforming Work requires design

modifications, such re-design shall be performed by the Engineer of Record and costs shall be borne by the Contractor.

- G. Curing Box(es): Furnish climatically controlled curing box(es) for field storage of cast concrete cylinders or other samples. Multiple boxes shall be furnished when concrete placement activities are being performed at multiple locations across the project site. Curing box shall be manufactured and marketed for the specific purpose described herein and shall meet standards ASTM C31, C192 and C511. Curing box shall be used to maintain temperature and humidity of the concrete cylinder specimens for 48 hours. Cure box shall feature a digital thermometer, heat/cool indicator lights; temperature set buttons and a capacity of 22 standard 6-inch x 12-inch cylinders. Use of field constructed curing boxes will not be acceptable.
- H. Laboratory Tests: Where such inspection and testing are to be conducted by an independent laboratory agency, the sample(s) shall be selected by such laboratory or agency, or the Engineer, and shipped to the laboratory by the Contractor at Contractor's expense.
- I. Cancellations: Contractor shall give sufficient advance notice to Owner and Inspectors to allow rescheduling of their workload in the event of cancellation or time extension of any scheduled test or inspection. Any charges from an Inspector due to insufficient advance notice of cancellations or time extensions shall be borne by the Contractor, at the Owner's discretion.
- J. Code Compliance Testing: Inspections and tests required by codes or ordinances or by a plan approval authority, and made by a legally constituted authority, shall be the responsibility of, and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.
- K. Convenience Testing: Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.
- L. The Contractor shall provide and pay for other inspection and testing services where specified in the Construction Documents or required to obtain regulatory approval by State or other AHJ.

1.8 TEST FAILURES

- A. General: The Owner may require re-test of a sampled material when a sample or procedure has failed to pass the required tests. In such cases, two samples shall be tested, and the material shall be rejected if either sample fails. In the event any test or inspection indicates failure of a material or procedure to meet requirements of Construction Documents, all costs for re-testing or re-inspection shall be borne by the Contractor.

1.9 REPORTING TEST FAILURES

- A. General: Immediately upon determination of a test failure, the Owner's Inspector shall telephone the test results to the Owner, Engineer, and Contractor. On receipt of the formal report from the Testing Agency, by the end of the following day the Owner's Inspector shall send written test results to those named on the distribution list.

- B. Contractor shall similarly report test failures to Owner resulting from work of testing agencies provided by the Contractor.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 52 50
CONTRACTOR'S FACILITIES, UTILITIES, AND STAGING AREAS

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish, install, and maintain staging areas and temporary utilities required for construction and remove upon completion of the work.
- B. Up to the discretion of the contractor on whether a field office will be provided. The contractor shall be responsible for site location, permitting, and all other responsibilities to set up a field office.

PART 2 PRODUCTS

2.1 OFFICE AND STAGING AREAS

- A. The Contractor shall establish a staging area for construction as required. Allowable staging areas will be designated by the Owner. Any required grading within the staging areas shall be the responsibility of the Contractor and shall be approved by Owner and Engineer. The Contractor shall be solely responsible for damages to equipment or materials due to heavy rains or flooding.

2.2 POWER AND LIGHTING

- A. The Contractor shall provide and pay for temporary power for construction used by the Contractor. The Contractor shall make arrangements with the electrical utility and with the Owner for power takeoff points from the existing service, voltage and phasing requirements, transformers and metering and shall pay the costs and fees arising therefrom. The Contractor shall provide the special connections required for his work.
- B. The Contractor shall provide sufficient electrical lighting so that all work may be done in an efficient manner when there is not sufficient daylight. The Contractor shall remove all temporary lighting following installation and proper operation of permanent lighting.

2.3 TELEPHONE

- A. The Contractor shall provide telephone service for all construction site offices; cell phones are an acceptable substitute.

2.4 WATER

- A. All water for testing, flushing, and construction will be provided to the Contractor by the Owner. The Contractor shall be required to obtain a meter from the Owner and meter all water use for the project.

2.5 SANITARY FACILITIES

- A. The Contractor shall provide toilet and wash-up facilities for his workforce at the site of the work. The facilities shall comply with all applicable laws, ordinances and regulations pertaining to the public health and sanitation of dwellings.

PART 3 EXECUTION

3.1 GENERAL

- A. Contractor shall maintain and operate systems to assure continuous service. The Contractor shall remove temporary materials and equipment when no longer required for the work.

END OF SECTION

SECTION 01 66 00
PRODUCT STORAGE AND PROTECTION

PART 1 GENERAL

1.1 SCOPE

- A. The work under this Section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the Work.
- B. The Contractor shall be responsible for selecting and securing a storage site or sites necessary for the construction of this Project.

1.2 STORAGE AND PROTECTION

- A. Storage:
 - 1. Maintain ample way for foot traffic at all times, except as otherwise approved by the Engineer. 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. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered but not installed in the Work.
 - 2. All property damaged by reason of storing of material shall be properly replaced at no additional cost to the Owner.
 - 3. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
 - 4. All materials shall meet the requirements of these Specifications at the time that they are used in the Work.
 - 5. Store products in accordance with manufacturer's instructions.
- B. Protection:
 - 1. Use all means necessary to protect the materials, equipment, and products of every section before, during and after installation and to protect the installed work and materials of all other trades.
 - 2. All materials shall be delivered, stored, and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism, or other causes.
 - 3. Substantially constructed weathertight storage sheds with raised floors shall be provided and maintained as may be required to protect adequately those materials and products stored on the site which may require protection from damage by the elements.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the Owner.
- D. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times. Compressors, blowers,

pumps, motors, valves, control panels, instrumentation, electrical equipment, and other equipment having antifriction or sleeve bearings shall be stored in weathertight warehouses which are maintained at a temperature of at least 60 degrees F. Other equipment may be stored outside under cover. All equipment shall be stored above ground level and adequately supported on wood blocking or other approved support material. Printed storage instructions of the manufacturers shall be strictly adhered to.

- E. Painted, anodized, or otherwise coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. All coated surfaces which are damaged prior to acceptance of equipment shall be cleaned and coated to the satisfaction of the Engineer with the same or equivalent coating used in the original application.
- F. Electrical equipment, motors, controls, and insulation shall be protected against moisture or water damage. All space heaters provided in the equipment shall be kept connected and operating at all times until equipment is placed in service. Electrical equipment stored without space heaters shall be provided with desiccants to protect against moisture damage. Desiccant shall be silica gel in porous bags at not less than 1 ounce per cubic foot of volume. Desiccant shall be replaced periodically.
- G. Electrical equipment and instrumentation shall be stored in a location that is free from excessive or injurious amounts of vibration.
- H. Rotating equipment such as pumps, motors, fans, and compressors shall be rotated periodically. In the absence of specific exercising instructions by the equipment manufacturers, each item of rotating equipment shall be rotated a minimum of 10 revolutions at intervals not to exceed 20 days. When shafts are too difficult to rotate by hand, nonmetallic grips shall be used to turn the shafts.
- I. Vehicles such as trucks, forklifts, tractors, lawn mowers and other engine powered equipment shall be started up and operated at intervals not to exceed 15 days. Equipment shall be run until engine temperatures and pressures are in normal operating ranges. All lifting, lowering, tilting, loading, and unloading accessories shall be operated at least once during the exercise period. Equipment shall be moved under power from the parked position and run a sufficient distance so as to ensure proper lubrication of drive train and suspension components. All operators employed to exercise the vehicles shall be qualified and thoroughly familiar with the proper operation of the equipment. Forklifts, tractors, lawn mowers and other small engine powered equipment shall be stored indoors in garages or other suitable structures. Trucks stored outdoors shall be washed using approved materials at intervals not to exceed 15 days. All exercising and storage of vehicular equipment shall be conducted in a manner acceptable to the Engineer.
- J. Interiors of gear and bearing cases housing oil lubricated gears and bearings shall be filled with a rust inhibiting oil prior to storage or, if extended storage is anticipated, coated periodically with a rust inhibiting oil mist at intervals of time acceptable to the Engineer. Interiors of large pumps and compressors shall be protected using vapor phase inhibitor paper or porous bags of rust inhibiting, vapor emitting crystals. Exposed shafts shall be coated with rust preventative compound, then wrapped with oil impregnated paper and polyethylene film and sealed with waterproof tape prior to shipment.

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

- K. Individually packaged, unpainted steel parts shall be protected by a wrapping of vapor phase inhibiting or oil impregnated paper and polyethylene film prior to shipment.
- L. Parts and equipment not requiring periodic inspection or maintenance shall be stored unopened in their original packaging until used.
- M. Parts, instruments, controls, and small items of equipment shall be stored above ground or floor level on suitable shelves or racks in a heated, watertight warehouse.
- N. Flanged openings on equipment shall be covered with suitable solid wooden or metal blanks securely bolted to the flange using a minimum of four bolts and a suitable rubber gasket. Ends of threaded pipe and fittings shall be sealed watertight with metal or plastic caps. Threaded openings shall be sealed watertight with metal or plastic plugs. Other openings shall be sealed with two layers of 6 mil polyethylene securely taped in place with waterproof tape.
- O. A maintenance log on each item of mechanical and electrical equipment requiring periodic attention in storage shall be maintained by the Contractor. Oil and grease changes, exercising, desiccant replacement, nitrogen purge checks, heater checks, insulation checks and other periodic maintenance shall be entered in the log. The maintenance log shall be made available to the Engineer on request.
- P. A resistance test shall be performed on all motor windings and heater elements following storage and prior to installation as a check for insulation deterioration or moisture damage during storage.
- Q. Immediately prior to installation, equipment shall be cleaned of any protective coatings used during storage and any rust, dirt, grit, or other foreign material shall be removed.
- R. After installation and prior to start up, all grease lubricated joints, shaft couplings and bearings shall be flushed out and regreased. All oil reservoirs and sumps shall be completely drained and flushed and refilled with the proper lubricant. Screens and filters shall be checked for contamination and replaced if necessary. The equipment shall then be tagged, signed, and dated, indicating that the equipment has been properly lubricated for startup.
- S. After storage, rubber parts such as valve seats, diaphragms, expansion joints, gaskets, hoses, and shaft couplings shall be checked for hardening or cracking. Deteriorated parts shall be replaced prior to start up by the Contractor at Contractor's own expense.
- T. Unless otherwise permitted in writing by the Engineer, building products and materials such as cement, grout, plaster, gypsum board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.
- U. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.3 EXTENDED STORAGE

- A. In the event that certain items of major equipment such as air compressors, pumps and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer.
- B. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

1.4 OWNER FURNISH EQUIPMENT

- A. Where required, the Contractor shall provide storage and protection for all Owner furnished equipment and materials, including extended storage as specified above.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 71 33

PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies protection and maintenance of underground and above ground utilities, structures, fences, parking strips, sidewalks, driveways, streets, and other improvements which may be affected by the work.

1.2 SUBMITTALS

- A. Procedures: Section 01 33 00.
- B. Action submittal items:
 - 1. Listing and schedule of all potholing.
 - 2. Listing of all utilities/facilities to be physically protected and relocated.
- C. Informational submittal items for this section:
 - 1. Shoring for all affected structures and utilities. Submit detail drawings of proposed methods to support, protect, and buttress utilities and structures where the depth of the excavation is greater than the horizontal distance from the structure or utility.

1.3 LOCATION OF EXISTING UNDERGROUND FACILITIES

- A. The Drawings indicate the existence of underground facilities known to the Owner within the site and right of way. Utilities are shown schematically on the plans and are not necessarily accurate in location as to plan or elevation.
- B. The Contractor shall familiarize himself with and comply with the provisions of O.C.G.A. Section 25-9-1 et. seq.
- C. The Contractor shall call, by law, the Utilities Protection Center, d/b/a Georgia 811 at "811-inch or 1-800-282-7411 and shall request that all owners of utilities, including gas companies, electric companies, telephone companies, cable television companies and governmental units, prior to starting any excavation of the project, locate and mark their respective facilities.
- D. Locate existing underground utilities. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict.
- E. Excavate and expose all major and minor existing utilities prior to new construction to determine utility elevations in relation to the new facilities.
- F. Examine and repair all pipelines prior to pipelines being buried.

1.4 EXISTING UTILITIES AND FACILITIES

- A. Protect, modify, and/or relocate all existing utilities required to complete the work.

- B. The locations of existing major utilities, whether above ground or underground, are indicated on the Drawings. This information has been obtained from utility maps and field surveys. The Owner does not guarantee the accuracy or completeness of this information, and it is to be understood that other above ground or underground facilities not shown on the Drawings may be encountered during the course of the work.
- C. Contractor shall be responsible for damages resulting from any failure to contact utility owners for location, routing, and marking of a specific utility and its subsequent effects.
- D. The Drawings may show underground utilities which are to be relocated. Contractor shall be responsible for all these relocations prior to commencing work in the area.
- E. Protect, modify, or relocate existing utilities and facilities required to accommodate Contractor's means and methods. Specific means and methods to be utilized by the Contractor are not known to the Owner. Therefore, the Owner will not be liable for utility protection, modification, and relocation not shown on the Drawings that are required by the Contractor due to its means and methods. It is the Contractor's responsibility to determine the Work required by the Construction Documents and make provision for protection, modification, and relocation required. Coordinate all protection, modification, and relocation work through the affected utility. Complete Work to the utility owner's requirements and standards.
- F. Underground Utilities:
 - 1. For the purpose of this Section an underground utility will be defined as a transmission, collection, or distribution line where it would be customary to expect that drawings would exist for the line and the utility owner would be aware of the line.
 - 2. An existing underground utility is considered to be in conflict if it crosses or projects into the specified excavation at an elevation between the top and bottom of the new facility or when parallel to the new facility, and projects into the specified excavation.
 - 3. Contractor shall be responsible for all protection, affects, and damages on utilities not in conflict with the new construction, whether or not the utilities are shown on the Drawings.
 - 4. When not shown on the Drawings and in conflict with the new construction, meet and agree with the Owner on how to proceed.
 - 5. When not shown on the Drawings and no conflict with the new facility exists, no additional payment will be considered.
 - 6. When in a substantially different location and not in conflict with the new construction, no additional payment will be considered.
 - 7. When in a substantially different location and in conflict with the new construction, reimbursement for additional work per the Supplemental General Conditions.
- G. Abandoned pipelines shown on the Drawings shall be removed and plugged per the local agency requirements when encountered.
- H. Locate existing underground utilities with the field staking. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict

I. Storm and Sanitary Sewers:

1. Existing live sewers shall remain in service. Adequate provision shall be made for disposal of existing sewage flow. The Contractor at no additional cost shall immediately repair construction damage to the existing sewer system and manholes to a condition equal to or better than that existing prior to the damage. Repair all damage which results from the disturbance of the existing sewer.
2. Remove water accumulating during construction from the new sewers and prevent it from entering existing lines. Flush existing pipes which were affected by the construction to the point of the next upstream connection and repair any pipelines or manholes damaged by gravel, rocks, or other debris that has entered the existing system during construction. The physical connection to an existing manhole or sewer line shall not be made until so authorized by the Owner.

J. Aboveground Electrical, Cable, and Communication Facilities:

1. Attention is called to all overhead items including, but not limited to, power and telephone lines, temporary traffic signals, traffic signal mast arms, overhead sign bridges, sign support span wires, signs, and streetlights.
2. Observe the location of these overhead facilities and plan and conduct work operations, accordingly.
3. Take precautions to protect and avoid damage to all overhead facilities.
4. Relocate facilities as required to meet the means and methods to be utilized.
5. Observe and investigate the presence of facilities that may be affected by the work. Consult with and rely on the information given by utility owners and operators to determine the extent of any hazards and measures required. Determine the extent of any hazard created by facilities in all areas and follow approved safety procedures during the work.
6. Support poles at risk of being undermined by the work.
7. Follow the requirements of Georgia Power for all energized primary conductors. For 50 kV lines and less, at no time shall personnel or equipment approach closer than 10 feet to any energized primary conductors. For greater than 50 kV, meet the requirements of Georgia Power.
8. Georgia Power and the Owner have agreed that a limited number of outages of the primary high voltage feeds to the plant substation will be performed by Georgia Power at no cost to the Owner. These are intended to be used for mobilization and demobilization of construction equipment associated with the project. Outages will last no longer than 48 hours, and Contractor shall notify Georgia Power a minimum of 7 days in advance of the required outage and shall coordinate with the utility's forces to de-energize and re-energize the primary feeds. A maximum of six (6) outages will be performed at no cost. Additional outages required for Contractor's operations shall be provided by Contractor at no additional cost to the Owner.

K. Underground Electrical, Cable, and Communication Facilities:

1. Determine the protection necessary to proceed safely to protect these underground facilities.

L. Gas:

1. As required by the appropriate utility owner, protect, maintain, support in place, or relocate all gas mains crossing the pipeline trenches.

2. Provide a minimum of 12 inches of clearance, measured from edge to edge, between gas mains or gas service lines and new facilities. If relocating either utility is not practical, a protective wrap shall be provided for the entire distance where less than 12 inches of vertical clearance and less than 6 inches of horizontal clearance are provided. Wrapping material shall consist of either a split polyvinyl chloride (PVC) pipe or PVC wrapping of at least 0.04 inch in thickness and shall be applied to either one of the pipes.
3. All abandoned gas mains encountered in the trench area shall be removed.
4. All temporary gas service slack lines shall be protected and maintained during pipeline installation.
5. Notify the Owner and the utility at least two days (minimum of 48 hours) in advance of any excavation in the vicinity of any gas piping. The utility may require one of its inspectors to be onsite anytime work is conducted near gas lines.

M. Water:

1. As required by the appropriate utility, protect, maintain, support in place, or relocate all water pipelines affected by the work.
2. Maintain water service along the alignment of work at all times.
3. Thrust blocks are not shown on the Drawings and shall be assumed to be present at all water line deflections of 12.5 degrees or greater.
4. Notify the Owner in writing immediately of any damage. Begin repairs immediately, and work continuously until water service is restored.

N. Roadways:

1. Take adequate precautions to protect existing sidewalks, curbs, pavements, utilities, adjoining property, and structures, and avoid damage.
2. Traffic signage, paint striping, and channelization shall be protected and replaced if damaged.
3. Maintain the existing illumination pattern for signs and roads at all times.
4. Install temporary roadway lighting as necessary.
5. Access for emergency equipment shall be maintained at all times.

1.5 SHORING AND BRACING

- A. Shore up, brace, under-pin, and protect as necessary, the foundations and other parts of existing structures adjoining the site of the work that may be affected by the work. Contractor is responsible for any damages because of settlements or the loss of lateral or subjacent support of adjoining property and from all loss and damages to adjoining and adjacent structures and their premises.
- B. Fully comply with the requirements of the authority having jurisdiction (AHJ) and the State of Georgia, as applicable.

1.6 EMERGENCIES

- A. Whenever work endangers the safety of life or property, including adjoining property or property in the immediate proximity of the work, take all reasonable and prudent actions to prevent threatened loss or injury.

PART 2 NOT USED

PART 3 EXECUTION

3.1 GENERAL

- A. Contact the Owner and the affected utilities prior to an excavation per the Supplemental General Conditions.
- B. Pothole to locate and expose all utility locations to be affected by the work prior to new construction in the area of the utility. Adjust work when location of utility is different than shown on the Drawings and materially impacts construction. If the utility requires relocation not shown on the Drawings and the Contractor incurs additional cost, then the Owner will consider additional costs. Relocation of minor utilities such as irrigation lines less than 4 inches, water service lines, building drainage pipes will be considered incidental and not considered for additional costs.
- C. If damage to a utility occurs, repair damage to the requirements of the utility owner prior to backfilling said utility.

END OF SECTION

SECTION 01 74 23
CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.1 SCOPE

- A. This Section covers the general cleaning which the Contractor shall be required to perform both during construction and before final acceptance of the Project unless otherwise shown on the Drawings or specified elsewhere in these Specifications.

1.2 QUALITY ASSURANCE

- A. Daily, and more often, if necessary, conduct inspections verifying that requirements of cleanliness are being met.
- B. In addition to the standards described in this Section, comply with all pertinent requirements of governmental agencies having jurisdiction.

1.3 HAZARDOUS MATERIAL AND WASTE

- A. The Contractor shall handle hazardous waste and materials in accordance with applicable local, state, and federal regulations. Waste shall also be disposed of in approved landfills as applicable.
- B. The Contractor shall prevent accumulation of wastes which create hazardous conditions.
- C. Burning or burying rubbish and waste materials on the site shall not be allowed.
- D. Disposal of hazardous wastes or materials into sanitary or storm sewers shall not be allowed.

1.4 DISPOSAL OF WASTE

- A. The definitions contained in Georgia Environmental Protection Division Rules 391-3-4-.01 shall be applicable to this Project. The term waste shall include excess and surplus materials and shall include liquid and solid wastes.
- B. Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
- C. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on-site.
- D. Remove and transport waste in a manner that will prevent spillage on adjacent surfaces and areas.
- E. Burning: Do not burn waste materials on site.

- F. Waste removed from the Project site shall be disposed of in sites permitted by the Georgia Environmental Protection Division for the acceptance of type of waste being disposed. The acceptable types of permitted disposal facilities are as follows:
 - 1. Inert Waste Landfills
 - 2. Municipal Solid Waste Landfills
 - 3. Municipal Solid Waste Landfills permitted to receive only construction and demolition wastes.
- G. Exceptions to Paragraph F are as follows:
 - 1. Hazardous waste shall be disposed of in accordance with Georgia Environmental Protection Division Rules 391-3-11.
 - 2. Asbestos-containing waste shall also be handled and disposed in accordance with Georgia Environmental Protection Division Rules 391-3-14.
 - 3. Excess earth material and excess excavated rock material may be placed on sites for which the Contractor provides to the Owner a signed affidavit from the property owner that the placement of such material is acceptable to the property owner. The Contractor and property owner shall be responsible for all permitting of such disposal.
- H. No waste shall be placed at a transfer station facility.
- I. The Contractor shall maintain records related to all waste removed from the Project site so as to allow the Owner or the Engineer to readily determine the following:
 - 1. Date waste removed from Project site.
 - 2. Name of hauler (company and driver) transporting such waste.
 - 3. General description of waste transported.
 - 4. "Truck tickets" indicating the waste disposal site and amount of waste disposed therein.
- J. For all wastes hauled to any landfill, the handler of such wastes must be licensed under Permit-by-Rule in accordance with Georgia Environmental Protection Division rules 391-3-4-06.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS AND EQUIPMENT

- A. Provide all required personnel, equipment and materials needed to maintain the specified standard of cleanliness.

2.2 COMPATIBILITY

- A. Use only the cleaning materials, methods and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material, or as approved by the Engineer.

PART 3 EXECUTION

3.1 PROGRESS CLEANING

A. General

1. Do not allow the accumulation of scrap, debris, waste material and other items not required for construction of this Work.
2. At least each week, and more often, if necessary, completely remove all scrap, debris and waste material from the job site.
3. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the environment.

B. Site

1. Daily, and more often, if necessary, inspect the site and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.
2. Restack materials stored on site weekly.
3. At all times maintain the site in a neat and orderly condition which meets the approval of the Engineer.

C. Structures

1. Weekly, and more often, if necessary, inspect the structures and pick up all scrap, debris, and waste material. Remove all such items to the place designated for their storage.
2. Weekly, and more often, if necessary, sweep all interior spaces clean. "Clean", for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by using a handheld broom.
3. As required preparatory to installation of successive materials, clean the structures or pertinent portions as recommended by the manufacturer of the successive material.
4. Following the installation of finish floor materials, clean the finish floor daily. "Clean", for the purpose of this paragraph, shall be interpreted as meaning free from all foreign material which, in the opinion of the Engineer, may be injurious to the finish floor material.
5. Schedule cleaning operation so that dust and other contaminants resulting from cleaning operations will not fall on wet, recently painted surfaces.

3.2 FINAL CLEANING

- A. Definitions: Unless otherwise specifically specified, "clean" for the purpose of this Article shall be interpreted as the level of cleanliness generally provided by commercial building maintenance subcontractors using commercial quality building maintenance equipment and materials.
- B. General: Prior to completion of the Work, remove from the job site all tools, surplus materials, equipment, scrap, debris and waste. Conduct final progress cleaning as described in 3.01 above.

- C. Site: Unless otherwise specifically directed by the Engineer, hose down all paved areas on the site and all public sidewalks directly adjacent to the site; rake clean other surfaces of the grounds. Completely remove all resultant debris.
- D. Structures
 - 1. Remove all traces of soil, waste material, splashed material, and other foreign matter to provide a uniform degree of exterior cleanliness. Visually inspect all exterior surfaces and remove all traces of soil, waste material, and other foreign matter. Remove all traces of splashed materials from adjacent surfaces. If necessary to achieve a uniform degree of exterior cleanliness, hose down the exterior of the structure. In the event of stubborn stains not removable with water, the Engineer may require light sandblasting or other cleaning at no additional cost to the Owner.
 - 2. Visually inspect all interior surfaces and remove all traces of soil, waste material, smudges, and other foreign matter. Remove all paint droppings, spots, stains, and dirt from finished surfaces.
 - 3. Clean all glass inside and outside.
 - 4. Polish all surfaces requiring the routine application of buffed polish. Provide and apply polish as recommended by the manufacturer of the material being polished.
- E. Post Construction Cleanup: All evidence of temporary construction facilities, haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other evidence of construction, shall be removed as directed by the Engineer.
- F. Restoration of Landscape Damage: Any landscape feature damaged by the Contractor shall be restored as nearly as possible to its original condition at the Contractor's expense. Restoration shall be performed to the satisfaction of the Engineer.
- G. Timing: Schedule final cleaning as approved by the Engineer to enable the Owner to accept the Project.

3.3 CLEANING DURING OWNER'S OCCUPANCY

- A. Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning of the occupied spaces shall be as determined by the Engineer in accordance with the Supplementary Conditions of the Contract Documents.

END OF SECTION

SECTION 01 75 00
SYSTEM TESTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section contains requirements for the Contractor's performance in documenting testing work required under the contract.
- B. In addition, this section contains requirements for the Contractor's performance during installed performance testing of all piping, mechanical, electrical, and instrumentation systems provided under the contract.
- C. This section supplements, but does not supersede, specific testing requirements found elsewhere in these Specifications and as required by the manufacturers.
- D. The Contractor is made aware that each system requires specific performance and operational tests.

1.2 QUALITY ASSURANCE

- A. Contractor's Quality Assurance Manager:
 - 1. The Contractor shall appoint an operations engineer or Engineer and Owner approved equally qualified operations specialist as Quality Assurance Manager to manage, coordinate, and supervise the Contractor's quality assurance program.
 - 2. The Quality Assurance Manager shall have at least five (5) years of total experience, or experience on at least five (5) separate projects, managing the startup commissioning of mechanical, electrical, instrumentation, and piping systems.
 - 3. Operations specialists shall have equivalent experience in pumping station operation and maintenance.
- B. Quality Assurance Program:
 - 1. The quality assurance program shall be developed by the Contractor and shall include:
 - a. A testing plan setting forth the sequence in which all testing work required under this Specification will be implemented;
 - b. A documentation program to record the results of all equipment and system tests;
 - c. An installed performance testing program for all mechanical, electrical, instrumentation equipment and systems installed under the contract;
 - d. A calibration program for all instruments, meters, monitors, gauges, and thermometers installed under the contract;
 - e. A calibration program for all instruments, gauges, meters, and thermometers used for determining the performance of equipment and systems installed under the contract; and
 - f. A testing schedule conforming to the requirements specified in Part 2.
 - 2. For the purposes of this section, a system shall include all items of equipment, devices, and appurtenances connected in such a fashion as their operation or

function complements, protects, or controls the operation or function of the equipment.

3. The Quality Assurance Manager shall coordinate the activities of the Contractor and all subcontractors and suppliers to implement the requirements of this section.

C. Calibration:

1. All test equipment (gauges, meters, thermometers, analysis instruments, and other equipment) used for calibrating or verifying the performance of equipment installed under the contract shall be calibrated to within plus or minus 2 percent of actual value at full scale.
2. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale.
3. Pressure gauges shall be calibrated in accordance with ANSI/ASME B40.1.
4. Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a certified calibration curve.
5. Liquid flow meters, including all open channel flow meters and all meters installed in pipelines with diameters greater than two (2) inches shall be calibrated in situ using either the total count or dye dilution methods as referenced in 01 75 00-1.02 D, below.
6. Gas flow meters installed in piping systems with diameters greater than six (6) inches shall be calibrated in situ using the pitot tube velocity averaging method as referenced in 01 75 00-1.02 D, below.
7. Flow meter calibration work shall be performed by individuals skilled in the techniques to be employed.
8. Calibration tests for flow metering systems shall be performed over a range of not less than 10 percent to at least 75 percent of system full scale.
9. At least five (5) confirmed valid data points shall be obtained within this range.
10. Confirmed data points shall be validated by not less than three (3) test runs with results which agree within plus or minus 2 percent.

D. References:

1. This section contains references to the documents set out in the chart below. They are a part of this section as specified and modified. In case of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI/ASME B40.1	Gauges Pressure Indicating Dial Type—Elastic Element
ASTM E77	Method for Verification and Calibration of Liquid-in-Glass Thermometers
ASHRAE 41.8	Standard Methods of Measurement of Flow of Gas
Dye Dilution Calibration Method	Flow Measurements in Sanitary Sewers by Dye Dilution, Turner Designs Mountain View, California
	Flow Measurement in Sewer Lines by the Dye Dilution Method, Journal of the Water Pollution Control Federation, Vol. 55, Number 5, May 1983, pg. 531
	Flow Measurement in Open Channels and Closed Conduits, Vol 1, U.S. Department of Commerce, National Bureau of Standards, pg. 361
	Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter 16, Measurement of Discharge Using Tracers

1.3 SUBMITTALS

- A. Submittal material, to be submitted in accordance with Section 01 33 00 prior to the commencement of testing, shall consist of the following:
 1. A complete description of the Contractor's plan for documenting the results from the test program in conformance with the requirements of paragraph 01 75 00-2.02 A, including:
 - a. Proposed plan for documenting the calibration of all test instruments.
 - b. Proposed plan for calibration of all instrument systems, including flow meters and all temperature, pressure, weight, and analysis systems.
 - c. Sample forms for documenting the results of field pressure and performance tests.
- B. The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.
- C. Preoperational check-out procedures, reviewed and approved by the respective equipment manufacturers.
- D. Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under the contract.
- E. A schedule and subsequent updates, presenting the Contractor's plan for testing the equipment and systems installed under the contract.
- F. A schedule establishing the expected time period (calendar dates) when the Contractor plans to commence operational testing of the completed systems, along with a description of the temporary systems and installations planned to allow operational testing to take place.
- G. A summary of the Contractor's Quality Assurance Manager's qualifications, showing conformance to paragraph 01 75 00-1.02 A requirements
- H. Quality assurance program documentation.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Contractor shall prepare test plans and documentation plans as specified in the following paragraphs.
- B. The Engineer will not witness any test work for the purpose of acceptance until all test documentation and calibration plans and the specified system or equipment test plans have been submitted and accepted.

2.2 DOCUMENTATION

- A. Documentation Plans:
 - 1. The Contractor shall develop a records keeping system to document compliance with the requirements of this Section. Calibration documentation shall include identification (by make, manufacturer, model, and serial number) of all test equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory.
 - 2. Equipment and system documentation shall include date of test, equipment number or system name, nature of test, test objectives, test results, test instruments employed for the test and signature spaces for the Engineer's witness and the Contractor's quality assurance manager. A separate file shall be established for each system and item of equipment. These files shall include the following information as a minimum:
 - a. Metallurgical tests
 - b. Factory performance tests
 - c. Accelerometer and temperature recordings made during shipment.
 - d. Field calibration tests
 - e. Field pressure tests
 - f. Field performance tests
 - g. Field operational tests
 - 3. Section 01 99 90 contains samples showing the format and level of detail required for the documentation forms. The Contractor is advised that these are samples only and are not specific to this project or to any item of equipment or system to be installed under the contract.
 - 4. The Contractor shall develop test documentation forms specific to each item of equipment and system installed under the contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the Engineer as a condition precedent to the Contractor's receipt of progress payments in excess of 50 percent of the contract amount.
 - 5. Once the Engineer has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of the contract.

B. Test Plans:

1. The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under the contract. Each test plan shall be specific to the item of equipment or system to be tested. Test plans shall identify by specific equipment or tag number each device or control station to be manipulated or observed during the test procedure and the specific results to be observed or obtained. Test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors', and manufacturers' representatives to be present and expected test duration. As a minimum, the test plans shall include the following features:
 - a. Step-by-step proving procedure for all control and electrical circuits by imposing low voltage currents and using appropriate indicators to affirm that the circuit is properly identified and connected to the proper device;
 - b. Calibration of all analysis instruments and control sensors;
 - c. Performance testing of each individual item of piping, mechanical, electrical, and instrumentation equipment. Performance tests shall be selected to duplicate the operating conditions described in the project manual;
 - d. System tests designed to duplicate, as closely as possible, operating conditions described in the project manual; and
 - e. Shoring, bracing, pipe restraint, and other devices necessary to successfully complete the testing.
2. Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
3. As a condition precedent to receiving progress payments in excess of 75 percent of the contract amount, or in any event, progress payments due to the Contractor eight (8) weeks in advance of the date the Contractor wishes to begin any testing work (whichever occurs earliest in the project schedule), the Contractor shall have submitted all test plans required for the systematic field performance and operational tests for all equipment and systems installed under the contract.
4. Once the Engineer has reviewed and taken no exception to the Contractor's test plans, the Contractor shall reproduce the plans in sufficient number for the Contractor's purposes and an additional three (3) copies for delivery to the Engineer.
5. No test work shall begin until the Contractor has delivered the specified number of final test plans to the Engineer.

C. Testing Schedule:

1. The Contractor shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, shall detail the equipment and systems to be tested, and shall be coordinated with the Contractor's construction schedule specified in Section 01 32 16. The schedule shall show the contemplated start date, duration of the test and completion of each test.
2. The test schedule shall be submitted no later than four (4) weeks in advance of the date testing is to begin. The Engineer will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Engineer takes no exception.

3. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily and meeting the requirements of these Specifications.

PART 3 EXECUTION

3.1 GENERAL

- A. The Quality Assurance Manager shall organize teams made up of qualified representatives of the Contractor, equipment suppliers, subcontractors, the Contractor's independent testing laboratory, and others, as appropriate, to efficiently and expeditiously calibrate and test the equipment and systems installed and constructed under the contract.
- B. The objective of the testing program shall be to demonstrate, to the Engineer's complete satisfaction, that the structures, systems, and equipment constructed and installed under this contract meet all performance requirements and the facility is ready for the commissioning process to commence. In addition, the testing program shall produce baseline operating conditions for the Owner to use in a preventive maintenance program.

3.2 CALIBRATION OF FIXED INSTRUMENTS

- A. Calibration of analysis instruments, sensors, gauges, and meters installed under this contract shall proceed on a system-by-system basis. No equipment or system performance acceptance tests shall be performed until instruments, gauges, and meters to be installed in that particular system have been calibrated and the calibration work has been witnessed by the Engineer.
- B. All analysis instruments, sensors, gauges, and meters used for performance testing shall be subject to recalibration to confirm accuracy after completion, but prior to acceptance of each performance test. All analysis instruments, sensors, gauges, and meters installed under the contract shall be subject to recalibration as a condition precedent to commissioning under the provisions of Section 01 91 00.

3.3 SYSTEM AND EQUIPMENT PERFORMANCE TESTS

- A. General:
 1. Each item of mechanical, electrical, and instrumentation equipment installed under the contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, and piping system installed or modified under this contract shall be tested in accordance with the requirements of these Specifications.
 2. Performance testing of the force main will include individual testing of each pipe material as described in Part 1. Once all performance testing for each pipe material has been successfully completed, the force main will be plugged, filled and pressurized. The force main will be pressurized so that no portion of the force main experiences pressure in excess of its rated operating pressure and held for three (3) hours, with no visible leaks or pressure drops, or the lesser of that allowed for any of the individual pipe materials.
 3. Operational tests may not proceed for any equipment or system without successful completion of the respective performance testing.

4. Performance tests shall consist of the following:
 - a. Pressure and/or leakage tests
 - b. Electrical testing as specified in the Contract Documents
 - c. Wiring and piping, individual component, loop, loop commissioning and tuning testing
 - d. Preoperational checkout for all mechanical equipment. Preoperational check-out procedures shall be reviewed and approved by the respective equipment manufacturers.
 - e. Initial operation tests of all mechanical, electrical, and instrumentation equipment and systems to demonstrate compliance with the performance requirements of this project manual.
 5. In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered only on the specific written authorization of the Engineer after receipt of a written request, complete with justification of the need for the change in sequence.
- B. Pressure and Leakage Tests:
1. Pressure and leakage tests shall be conducted in accordance with applicable portions of specifications. All acceptance tests shall be witnessed by the Engineer. Evidence of successful completion of the pressure and leakage tests shall be the Engineer's signature on the test forms prepared by the Contractor.
- C. Functional Checkout:
1. Prior to energization (in the case of electrical systems and equipment), all circuits shall be rung out and tested for continuity and shielding in accordance with the procedures required in the Contract Documents.
- D. Component Calibration and Loop Testing:
1. Prior to energization (in the case of instrumentation system and equipment), all loops and associated instruments shall be calibrated and tested.
- E. Electrical Resistance:
1. Electrical resistance testing shall be in accordance with the Contract Documents.
- F. Preoperational Tests:
1. Preoperational tests shall include the following:
 - a. Alignment of equipment, using reverse dial indicator method;
 - b. Pre-operation lubrication; and
 - c. Tests per the manufacturers' recommendations for prestart preparation and preoperational check-out procedures.
- G. Functional Tests:
1. General:
 - a. Once all affected equipment has been subjected to the required preoperational check-out procedures and the Engineer has witnessed and has not found deficiencies in that portion of the work, individual items of equipment and systems may be started and operated under simulated operating conditions to

determine as nearly as possible whether the equipment and systems meet the requirements of these specifications.

- b. Potable or raw water may be used for the testing of all liquid systems except gaseous, oil, or chemical systems. Test media for gaseous, oil, or chemical systems shall either be the intended fluid or a compatible substitute.
 - c. The equipment shall be operated a sufficient period of time to determine machine operating characteristics, including noise, temperatures, and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls.
 - d. When testing requires the availability of auxiliary systems such as looped piping, electrical power, control air, or instrumentation which have not yet been placed in service, the Contractor shall provide acceptable substitute sources, capable of meeting the requirements of the machine, device, or system at no additional cost to the Owner.
 - e. Disposal methods for test media shall be subject to review by the Engineer.
 - f. During the functional test period, the Contractor shall obtain baseline operating data on all equipment with motors greater than 1 horsepower to include amperage, bearing temperatures, and vibration. The baseline data shall be collected for the Owner to enter in a preventive maintenance system.
 - g. Test results shall be within the tolerances set forth in the applicable sections of these Specifications. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory functional test, any doubt, dispute, or difference should arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the Owner may order the test to be repeated.
 - h. If the repeat test, using such modified methods or equipment as the Owner may require, confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner. Otherwise, the costs shall be borne by the Contractor. Where the results of any functional test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by the Contractor at his expense.
 - i. The Contractor shall provide, at no expense to the Owner, all power, fuel, compressed air supplies, water, and chemicals, all labor, temporary piping, heating, ventilating, and air conditioning for any areas where permanent facilities are not complete and operable at the time of functional tests, and all other items and work required to complete the functional tests. Temporary facilities shall be maintained until permanent systems are in service.
2. Retesting:
- a. If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the Engineer, be repeated within reasonable time and in accordance with the specified conditions.
 - b. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, including the costs of the Engineer, as a result of repeating such tests.

3. Post-Test Inspection:

- a. Once functional testing has been completed, all machines shall be rechecked for proper alignment and realigned, as required.
- b. All equipment shall be checked for loose connections, unusual movement, or other indications of improper operating characteristics. Any deficiencies shall be corrected to the satisfaction of the Engineer.
- c. All machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected.
- d. Any defects found during the course of the inspection shall be repaired or the specific part or entire equipment item shall be replaced to the complete satisfaction of the Engineer at no cost to the Owner.

3.4 OPERATIONAL TESTS

- A. Once all equipment and systems have been tested successfully individually, the Contractor shall fill all with the intended process fluids. After filling operations have been completed and prior to start-up and commissioning, the Contractor shall operate all pumping station systems for a continuous period of not less than 72 hours, simulating actual operating conditions to the greatest extent possible.
- B. The Contractor shall install temporary connections, bulkheads and make other provisions to recirculate process fluids or otherwise simulate anticipated operating conditions.
- C. During the operational testing period, the Contractor's Quality Assurance Manager and testing team shall monitor the characteristics of each machine and system and report any unusual conditions to the Engineer. This test will include operation under various loading conditions, as directed by the Engineer.
- D. The operational testing period shall commence after this initial period of variable operation. Should the operational testing period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the operational testing program shall be repeated until the specified continuous period has been accomplished without interruption. All process units shall be brought to full operating conditions, including temperature, pressure, and flow.
- E. All costs for water, fuel, power, and chemicals required during this operational test shall be borne by the Contractor. Process systems and units shall mean all materials and equipment provided in this contract.
- F. A detailed description of the operational test shall be included in the testing plan.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies the following sequence and procedures for Project closeout:
 - 1. Final Inspection (portions of the Work)
 - 2. Substantial Completion (portions of the Work per the Supplemental General Conditions)
 - 3. Final Completion (all Work per the Supplemental General Conditions)
 - 4. Final Acceptance (all Work per the Supplemental General Conditions)

1.2 FINAL INSPECTION

- A. Request for Final Inspection: complete the following actions prior to the Owner's Final Inspection.
 - 1. Submit a written notice that the Project is ready for Final Inspection. Include a written plan and schedule outlining all actions necessary to achieve Substantial Completion.
 - 2. Preliminary Cleaning per Section 01 74 23.
- B. Final Inspection: Upon receipt of the Request for Final Inspection, the Owner will commence Final Inspection and, as necessary, provide a Corrective Work Items List. If a list of Corrective Work Items List is issued, make the required corrections and/or identify items that Contractor feels are not required by the Construction Documents; resolve these items with the Owner.
- C. Reinspection: After completing the Owner's Corrective Work Items List and providing a Final Inspection Report noting completion of each item, request a re-inspection. Items whose completion is delayed due to circumstances acceptable to the Owner will be exceptions. Owner will confirm completion of the Corrective Work Items List. If Owner is required to perform more than one re-inspection, costs for additional inspections may be borne by the Contractor, at Owner's sole discretion.

1.3 SUBSTANTIAL COMPLETION

- A. Prior to Substantial Completion: Substantial Completion is achieved when the portion of Work, other than incidental Corrective Work Items or Punch List items, is complete. Tasks to complete include, but are not limited to, the following:
 - 1. Work is complete and correct to the satisfaction of the Owner.
 - 2. Removal of temporary facilities and controls not required in other areas.
 - 3. Final cleaning complete per Section 01 74 23.
 - 4. Completion of all testing, training, and commissioning per Section 01 75 00.
 - 5. Certificate(s) of Occupancy submitted, as required.
- B. Substantial Completion: Upon satisfactory completion of all specified requirements, the Owner will issue a letter of Substantial Completion. The letter will identify the date of Substantial Completion and list any incomplete Work.

1.4 FINAL COMPLETION

- A. Prior to Final Completion: Final Completion is achieved when all Work is fully complete in accordance with the Construction Documents. Tasks to complete include, but are not limited to, the following:
 - 1. All Work is complete and correct to the satisfaction of the Owner.
 - 2. All temporary facilities and controls removed.
 - 3. All final cleaning complete per Section 01 74 23.
 - 4. Final Operation and Maintenance Manuals provision per Section 01 78 23.
 - 5. Warranties and Bond Manual submission per Section 01 78 36.
 - 6. Submittal of the Project Record Documents per Section 01 78 39.
 - 7. Spare parts delivery and acceptance per Section 01 78 43.
 - 8. Landscaping complete.
 - 9. All final permits submitted, including Certificates of Occupancy.
 - 10. All Change Orders are approved and signed by both parties.
 - 11. Draft Final Application for Payment submitted.
- B. Additional Contract Closeout Submittals: In addition to all other required specified above, Contractor shall provide the following submittals in accordance with Section 01 33 00.
 - 1. Submittal of complete set of approved shop drawings and samples
 - 2. Two copies of all Special Bonds, Special Warranties, and Service Agreements.
 - 3. Consent of Surety to Final Payment
 - 4. Releases or Waivers of Liens and Claims
 - 5. Release from Agreements per Paragraph 1.04.
 - 6. Registry of training sessions conducted and list of attendees for all manufacturer's operation and maintenance training session.
 - 7. Registry of final maintenance and lubrication of filter and/or oil lube protected equipment.
 - 8. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 33 00.
 - 9. A final written tabulation, plus other documentation as may be required, of all taxes, including sales tax, paid by the CONTRACTOR to assist the OWNER in obtaining sales and/or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia.
- C. Final Completion: Upon satisfactory completion of all Construction Document requirements, the Owner will approve and process the Final Application for Payment and establish the date of Final Completion.

1.5 RELEASES FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

- B. In the event Contractor is unable to secure written releases, inform the Owner of the reasons:
 - 1. Inform Owner of the reasons.
 - 2. Owner or its representatives will examine the site, and Owner will direct Contractor to complete Work that may be necessary to satisfy terms of the side agreement or special easement.
 - 3. Should Contractor refuse to perform this Work, Owner reserves the right to have it done by separate contract and deduct the cost of same from the Contract Price, or require the Contractor to furnish a satisfactory Bond in a sum to cover legal claims for damages.
 - 4. When Owner is satisfied that Work has been completed in agreement with the Contract Documents and terms of side agreement or special easement, the right is reserved to waive the requirement for written release if:
 - a. Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the side agreement or special easement, or
 - b. Contractor is unable to contact or has had undue hardship in contacting the grantor.

1.6 FINAL ACCEPTANCE

- A. Final Application for Payment approved, and payment made to Contractor.
- B. The Owner will establish the date of Final Acceptance and issue the Letter of Final Acceptance after the Contractor completes all Construction Document requirements.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SCOPE

- A. Operation and maintenance (O&M) instructions shall be provided in accordance with this section and as required in the technical sections of this project manual. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.
- B. O&M instructions must be submitted and accepted before on-site training may start.

1.2 TYPES OF INFORMATION REQUIRED

- A. General:
 - 1. O&M information shall contain the names, addresses, and telephone numbers of the manufacturer, the nearest representative of the manufacturer, and the nearest supplier of the manufacturer's equipment and parts. In addition, one or more of the following items of information shall be provided as applicable.
- B. Operating Instructions:
 - 1. Specific instructions, procedures, and illustrations shall be provided for the following phases of operations:
 - a. Safety Precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.
 - b. Operator Prestart: Provide requirements to set up and prepare each system for use.
 - c. Start-Up, Shutdown, and Post shutdown Procedures: Provide a control sequence for each of these operations.
 - d. Normal Operations: Provide control diagrams with data to explain operation and control of systems and specific equipment.
 - e. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
 - f. Operator Service Requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
 - g. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) which are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

C. Preventive Maintenance:

1. The following information shall be provided for preventive and scheduled maintenance to minimize corrective maintenance and repair:
 - a. Lubrication Data: Provide lubrication data, other than instructions for lubrication in accordance with paragraph 1.02 Operator Service Requirements.
 - 1) A table showing recommended lubricants for specific temperature ranges and applications;
 - 2) Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
 - 3) A lubrication schedule showing service interval frequency.
 - b. Preventive Maintenance Plan And Schedule: Provide manufacturer's schedule for routine preventive maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer's projection of preventive maintenance man-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft.

D. Corrective Maintenance:

1. Manufacturer's recommendations shall be provided on procedures and instructions for correcting problems and making repairs.
 - a. Troubleshooting Guides And Diagnostic Techniques: Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
 - b. Wiring Diagrams And Control Diagrams: Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type are identical to actual installation numbering.
 - c. Maintenance And Repair Procedures: Provide instructions and list tools required to restore product or equipment to proper condition or operating standards.
 - d. Removal And Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of test and illustrations.
 - e. Spare Parts And Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonably delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead time to obtain.
 - f. Corrective Maintenance Man-hours: Provide manufacturer's projection of corrective maintenance man-hours including craft requirements by type of craft. Corrective maintenance that requires participation of the equipment manufacturer shall be identified and tabulated separately.

E. Appendices:

1. The following information shall be provided; include information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment.
 - a. **Parts Identification:** Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
 - b. **Warranty Information:** List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
 - c. **Personnel Training Requirements:** Provide information available from the manufacturers to use in training designated personnel to operate and maintain the equipment and systems properly.
 - d. **Testing Equipment And Special Tool Information:** Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.3 TRANSMITTAL PROCEDURE

- A. Unless otherwise specified, O&M manuals, information, and data shall be transmitted in accordance with Section 01 33 00 accompanied by Transmittal Form 01 78 23-A and Equipment Record Forms 01 78 23-B and/or 01 78 23-C, as appropriate, all as specified in Section 01 99 90. The transmittal form shall be used as a checklist to ensure the manual is complete. Only complete sets of O&M instructions will be reviewed for acceptance.
- B. One (1) electronic and six (6) hard copies of the specified O&M information in final format, with all prior comments addressed to the satisfaction of the Engineer, shall be provided following preliminary review and pre-final review of the O&M information.
 1. Electronic copies of O&M manuals also shall be provided per Section 01 33 00. For electronic copies, files shall be provided on CD/DVD/USB in an indexed PDF file format.
 2. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name and equipment number as it appears in the project manual.
 3. The information shall be organized in the binders in numerical order by the equipment numbers assigned in the project manual.
 4. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information.
 5. Binders shall be heavy-duty, d-ring.

- C. If manufacturers' standard brochures and manuals are used to describe O&M procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

1.4 PAYMENT

- A. Acceptable O&M information for the project must be delivered to the Engineer prior to the project being 65 percent complete. Progress payments for work in excess of 65 percent completion will not be made until the specified acceptable O&M information has been delivered to the Engineer.

1.5 FIELD CHANGES

- A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the Contractor to reflect any field changes or information requiring field data.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 78 36
WARRANTIES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies general administrative and procedural requirements for warranties required by the Construction Documents, including manufacturer's Standard Product Warranties and Special Warranties.
- B. Warrant for a period of minimum 1-year, unless otherwise specified in the contract documents, from the date of Owner's written acceptance of the Work and/or Owner's written final acceptance of the Project, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship. Promptly make such corrections as may be necessary by reason of such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period. If there is any discrepancy in the Construction Documents regarding the warranty period or its date of commencement, the passage granting the Owner the longest warranty period ending on the latest date shall govern.
- C. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors that are required to countersign Special Warranties with the Contractor.

1.2 DEFINITIONS

- A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
- B. Special Warranties are written warranties required by or incorporated in the Construction Documents, either to extend time limits provided by Standard Product Warranties or to provide greater rights to the Owner. Refer to individual sections of the Specifications for Special Warranty requirements.

1.3 WARRANTY REQUIREMENTS

- A. All warranties begin at the date of Substantial Completion for the entire project, or, for Work associated with an interim milestone, on the date of Substantial Completion for that milestone.
- B. When correcting warranted Work that has failed, remove, and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to access the failed, warranted Work.

- C. When Work covered by a warranty has failed and been corrected, replaced, retested, recommissioned, reinstate the warranty by written endorsement. The reinstated warranty shall equal the original warranty with an equitable depreciation adjustment.
- D. Upon determination that Work covered by a warranty has failed, correct or replace the Work to an acceptable condition complying with requirements of Construction Documents. The Contractor is responsible for the cost of correcting, replacing, retesting, and recommissioning defective Work regardless of whether the Owner has benefited from use of the Work.
- E. Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
- F. The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Construction Documents.
- G. The Owner reserves the right to refuse to accept Work for the Project where a Special Warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- H. Owner acceptance of warranties does not relieve the Contractor of the warranty requirements specified in the Supplemental General Conditions.
- I. Ensure all Standard Product Warranties and Special Warranties are transferrable to Owner.

1.4 SUBMITTALS

- A. Procedures: Section 01 33 00.
- B. Warranties and Bonds Manual: Assemble executed licenses, certificates, warranties, bonds, and any required service and maintenance contracts from the respective manufacturers, suppliers, and Subcontractors. Provide two (2) preliminary review copies, identified "Preliminary." Provide four (4) final signed copies of the Warranties and Bonds Manual following review and acceptance of the preliminary manual by the Owner.
 - 1. Out of the four final signed copies, one (1) shall be an original.
 - 2. Provide one (1) CD with scanned Adobe Acrobat (.pdf) files, including an index with hyperlinks to the individual sections.
- C. Include complete information for each of the following:
 - 1. Neatly typed Table of Contents, in a complete and orderly sequence.
 - 2. Product or work item, including applicable specification section number(s) per the Construction Documents
 - 3. Firm, with name of principal, address, telephone number, email address, and web site address
 - 4. Scope of warranty
 - 5. Start date of warranty or service and maintenance contract

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

6. Duration of warranty or service and maintenance contract
 7. Proper procedure in case of failure
 8. Instances which might affect validity of warranty or bond.
 9. Contractor, name or responsible principal, address, and telephone number.
 10. For Special Warranties, prepare a written document containing all pertinent information and ready for execution by the required parties.
- D. Copies shall be bound in slant-D, 3 ring view binders with an insert accepting clear vinyl overlay on the front cover and spine.
1. Provide cover slip sheet typed with "WARRANTIES AND BONDS", Project name, Project number, Contractor, and blank field for the date. Label volumes consecutively.
 2. Each copy shall have a typewritten index and tabbed dividers between equipment categories or specification sections.
 3. The contents of the manual shall be printed on white 8-1/2-inch x 11-inch acid free, recycled copy paper and shall not exceed 75 percent capacity of the binder.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.1 DEFINITIONS

- A. Record documents refer to those documents maintained and annotated by the Contractor during construction or developed after construction and are defined as:
 - 1. A neatly and legibly marked set of contract drawings showing the final location of piping, equipment, structures, electrical conduits, outlet boxes and cables.
 - 2. Specifications annotated with addenda and change order items, by section.
 - 3. Change order documents
 - 4. Submittals and product data
 - 5. Field test data
 - 6. Additional documents such as schedules, lists, drawings, and electrical and instrumentation diagrams are included in the specifications.
 - 7. Contractor layout and installation drawings
 - 8. As-built drawings by Georgia registered professional land surveyor (PLS), including digital version.
 - 9. Contractor's detailed tank design as built drawings

1.2 GENERAL REQUIREMENTS

- A. Unless otherwise specified, record drawings shall be full size and maintained in a clean, dry, and legible condition.
- B. Accuracy of Records:
 - 1. Unless noted otherwise, Record Drawings shall provide dimensions, distances, and coordinates to the nearest 0.1 foot.
 - 2. Unless noted otherwise, Record Drawings shall provide elevations to the nearest 0.01 foot for all pertinent items constructed by the Contractor.
 - 3. Coordinate changes within Record Documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
 - 4. Purpose of Project Record Documents is to document factual information regarding aspects of Work, both concealed and visible, to enable future modification of Work to proceed without lengthy and expensive site measurement, investigation, and examination.
- C. Make entries within 24 hours after receipt of information that a change in Work has occurred.
- D. Record documents shall not be used for construction purposes and shall be available for review by the Engineer during normal working hours.
- E. At the completion of the work, prior to final payment, all record drawings shall be submitted to the Engineer.

- F. The Contractor shall maintain on the Project site throughout the Contract Time an up-to-date set of Record Drawings.
- G. Prior to each request for partial progress payment, Owner or Engineer will review record drawings with Contractor.
- H. Progress payment requests shall not be processed unless record drawings are current.
- I. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of Record Documents. Failure to properly maintain, update, and submit Record Documents may result in a deferral by Engineer to recommend the whole or any part of the Contractor's Application for Payment, either partial or final.

1.3 CONTRACTOR MARK-UPS AND DATA ENTRY REQUIREMENTS

- A. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed.
- B. Annotations to the record drawings shall be made with an erasable colored pencil conforming to the following color code:
 - 1. Additions – Red
 - 2. Deletions – Green
 - 3. Comments – Blue
 - 4. Dimensions – Graphite
- C. Legibly mark drawings to record actual construction, including changes of dimension and detail; and changes made by Requests for Information (RFI), field order, work change directives, clarification memorandums or by change order.
- D. Provide locations of and dimensions of roadways, driveways, and parking areas.
- E. Legibly mark to record actual depths, horizontal and vertical location of underground facilities, piping, taps, fitting, underground structures, equipment, raceways, cables, and appurtenances referenced to permanent surface improvements.
- F. Provide elevation of piping through vaults / structures, invert elevation of all pipes entering manholes, junction boxes, valves, clean outs, etc. Provide center of manholes, and corners of facilities or structures with northing, easting and bottom / top elevations.
- G. The Contractor shall provide offset staking for the centerline of pipelines every 100 feet along the pipe (including all fittings and bends) – as installation of the pipeline progresses. The staking shall identify the distance to the centerline of the pipe and the depth of cover to the top of pipe. At the completion of construction, the Contractor shall provide coordinates for the centerline of the pipe, include depth of bury, based on staked offsets.
- H. The locations of site improvements, including underground utilities, shall be referenced to at least two easily identifiable, permanent landmarks (e.g., power poles, valve markers, etc.) or benchmarks.

- I. GPS Coordinates for all fire hydrants, valves, manholes, piping and other structures and appurtenances installed (see 1.04).
- J. The Contractor shall obtain a set of signed / sealed as-built drawings from the Georgia registered surveyor and submit to the Engineer.
- K. Record Drawings shall be prepared using a survey that ties the site and improvements horizontally and vertically to the following state plane coordinate system or as amended by the Owner.

Horizontal Control: North American Datum 83 (NAD83) (HARN) 1994

Vertical Control: North American Vertical Datum of 1988 (NAVD88).

Grid Zone: Georgia West 1002 (US Survey feet)

- L. Record Drawings shall have a title block indicating that the drawings are Record Drawings, the name of the company preparing the Record Drawings, and the date the Record Drawings were prepared.

1.4 GPS COORDINATES FOR WATER LINE PROJECTS

- A. At the completion of construction, the Contractor shall provide GPS coordinates for all newly installed and relocated fire hydrants, blow-offs, valves, valve vaults, master meter vaults, and dead ends. Coordinates shall be of survey grade quality (sub foot accuracy minimum) and provided in the Georgia State Plane Coordinates West Zone. Control shall be based on NAD 83 for horizontal and NAVD 88 for vertical. Coordinates shall be submitted in an ESRI shape file format.
- B. As installation of the utility pipeline progresses, the Contractor shall provide offset staking for the centerline of the utility pipe every 100 feet along the pipe. The staking shall identify the distance to the centerline of the pipe and the depth of cover to the top of pipe. At the completion of construction, the Contractor shall provide GPS coordinates for the centerline of the pipe, include depth of bury, based on staked offsets.

1.5 FINAL AS-BUILT TOPOGRAPHIC SURVEY

- A. Survey sufficient ground points and/or channel cross sections to represent all features within the limits of the survey to produce 1-foot interval topographic contours with a map scale of (1-inch = 20-foot). The boundary of the topographic contour survey area should extend to the project boundary.
- B. All piping, valves, vaults, manholes, controls, fences, gates, pavement limits, above ground structures, lights, posts, and all other miscellaneous site features.
- C. Identify the edge of pavement and elevations of all roads and centerline of all paths within the project boundary at a minimum of 25-foot intervals.
- D. Survey sufficient ground points to represent all features within the limits of the survey including fences, continuous berms, and swales (>10ft in length) that are generally parallel to the channel, tributaries and other storm drainage features (pipe outlets, washes, ditches, and swales).

- E. Survey up to 2 permanent benchmarks (as appropriate for site) and display on deliverable Drawing. Coordinate with Owner to determine approximate location of the permanent benchmarks. Permanent benchmark shall consist of 6-inch diameter schedule 40 PVC 18-inch long filled with concrete inside of pipe and extending 6-inch beyond outside of pipe.

1.6 SPECIFICATIONS

- A. Legibly mark each section to record:
 - 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
 - 2. Changes made by Requests for Information (RFI), field order, clarification memorandums, or by change order.

1.7 SUBMITTAL

- A. At contract closeout, deliver Record Documents to the Engineer for the Owner.
- B. Accompany submittal with transmittal letter, in duplicate, containing:
 - 1. Date
 - 2. Project title and number
 - 3. Contractor's name and address
 - 4. Title and number of each record document
 - 5. Signature of Contractor or Contractor's authorized representative

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

SECTION 01 78 43

SPARE PARTS AND MAINTENANCE MATERIALS

1.1 DESCRIPTION

- A. Provide spare parts manufactured by original equipment manufacturer.
- B. Provide maintenance materials identical to those installed.

1.2 QUALITY ASSURANCE

- A. Deliver required items to the Place of the Work and store in temporary locations determined by Contractor or permanent locations designated by Owner.
- B. Deliver and store items in original factory packaging or other securely packaged form.
- C. Identify, on carton or package, name of item, color or part number, as applicable. Identify equipment, system, area, room no., etc. for which each item is intended.
- D. Maintain an inventory list of all items delivered. For each item, record description of item, quantity, and location where stored.
- E. Stored items shall remain in Contractor's care, custody, and control until Interim Acceptance of the Work. Protect stored items against theft or damage.
- F. Handle items as necessary, until stored in permanent locations designated by Owner.

1.3 ACCEPTANCE

- A. Prior to requesting Owner's inspection for Interim Acceptance, do the following:
 - 1. Review Contract Documents and compare with inventory list to verify that all required items have been delivered.
 - 2. Verify that items listed on inventory list are in their designated storage locations.
 - 3. Inspect items to verify that they meet specified requirements and are in serviceable condition.
 - 4. Arrange for delivery of any missing items.
 - 5. Arrange for replacement of items not meeting specified requirements or not in serviceable condition.
 - 6. Provide the Owner with copy of inventory list indicating status of all required items.
 - 7. Review inventory list with the Owner during the Owner's inspection for Interim Acceptance.
 - 8. For items not delivered prior to Interim Acceptance of the Work, provide a duplicate copy delivery slip and obtain Owner's signature upon delivery. The Owner will only accept responsibility for care, custody, and control of items properly received and signed for.

PART 2 PRODUCTS

- A. All materials used in the work, including equipment, shall be new and unused.
 - 1. One (1) Reed HWFR Ratcheting Fire Hydrant Wrench.
 - 2. One (1) Pollardwater PP52301 5-Ft-9-FT Adjustable/Extendable Key.
 - 3. The electrical control shall be provided with a minimum of two (2) spare fuses of each type and rating used in the panel.
 - 4. One (1) control panel replacement battery of each type and rating used in the panel.
 - 5. One (1) touch-up painting repair kit for each color used.
 - 6. One (1) UltraHD 2-door rolling cabinet for storing Record Drawings, O&M manuals, maintenance schedules, and spare parts at the station.
 - 7. One (1) Rosemount 3051CG4A02A1AS5M6D1RK pressure transmitter assembly.

PART 3 NOT USED

END OF SECTION

SECTION 01 91 00
COMMISSIONING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section contains requirements for the Contractor's performance during the commissioning of the structures, equipment and systems constructed and installed during the course of this contract. All commissioning work, as described in this section, shall be performed by the Contractor.

1.2 QUALITY ASSURANCE

- A. Cleanup:
 - 1. Following completion of the operational testing period, the Contractor shall remove, clean, and replace all permanent and temporary filters and strainers in all pipeline systems; dewater and clean all sumps; and dewater all process units and other structures for final inspection as a condition precedent to commissioning.
- B. Commissioning Team:
 - 1. The Contractor shall assemble a commissioning team under the direction of an individual duly authorized to commit the Contractor's personnel and resources to respond to requests for assistance on the part of the Engineer or, through the Engineer, the Owner. The commissioning team shall consist of representatives of the Contractor's mechanical, electrical, and instrumentation subcontractors, and others as appropriate. The commissioning team shall be available at the site of the work during normal working hours (8 hours a day, 5 days a week, Saturdays, Sundays, and legal holidays excepted) and shall be available within 2 hours' notice at all other times upon notice by telephone. The commissioning team shall at all times be equipped and ready to provide for emergency repairs, adjustments, and corrections to the equipment and systems installed and modified as a part of this contract.

1.3 SUBMITTALS

- A. The following information shall be submitted to the Engineer in accordance with the provisions of Section 01 33 00:
 - 1. Detailed plans for commissioning each process unit and each system constructed or modified as a part of the work performed under this contract.
 - 2. The Contractor's plan for providing a commissioning team conforming to the requirements of paragraph 1.02 Commissioning Team during the commissioning period. The plan shall be complete with a daytime staffing plan and names, qualifications, and telephone numbers of those assigned to off-hour standby duty.

PART 2 PRODUCTS

2.1 SUMMARY

- A. Working with representatives of the Owner and the Engineer, the Contractor shall develop and produce a detailed, written plan for the startup and initial operation, under

actual operating conditions, of the equipment and systems installed and constructed under this contract. The document, after acceptance by the Engineer, shall serve as the guidance manual for the commissioning process.

PART 3 EXECUTION

3.1 SUMMARY

- A. After completion of the equipment and system performance and operational testing, where required, and agreement on the part of the Engineer that the systems did meet all test requirements, commissioning will begin. The commissioning period for the new systems shall be 2 weeks. The Contractor shall remove all temporary piping, bulkheads, controls, and other alterations to the permanent systems that may have been needed during the performance and operational testing and shall perform the tasks necessary to make the improvements constructed under this contract fully operational. The Engineer shall confirm in writing the date(s) that the system is ready for commissioning and on which actual commissioning activities commence. Activities conducted prior to such written confirmation shall not constitute commissioning.
- B. The Owner's operation and maintenance personnel will be responsible for operation of the systems to be commissioned. The portion of the work to be commissioned shall be fully operational, performing all functions for which it was designed.
- C. The Contractor shall be available at all times during commissioning periods to provide immediate assistance in case of failure of any portion of the system being constructed. At the end of the commissioning period and when all corrections required by the Engineer to assure a reliable and completely operational facility are complete, the Engineer shall issue a completion certificate. Each system shall have been issued a completion certificate as a condition precedent to the final acceptance of the work of this contract.
- D. During the commissioning period, the Owner shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials, required to keep the portion of the plant being commissioned, operational.

END OF SECTION

SECTION 01 99 90
REFERENCE FORMS

PART 1 FORMS

1.1 DESCRIPTION

- A. The forms listed below and included in this section are referenced from other sections of the project manual:

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 75 00-A	Equipment Test Report Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Equipment Record Form
09 90 00-A	Coating System Inspection Checklist
26 05 00-A	Wire and Cable Resistance Test Data Form

01 33 00-A. SUBMITTAL TRANSMITTAL FORM

Submittal Transmittal

Submittal Description:	Submittal No: ¹	Spec Section:
------------------------	----------------------------	---------------

	Routing	Sent	Received
Owner:	Contractor/CM		
Project:	CM/Engineer		
	Engineer/CM		
Contractor:	CM/Contractor		

We are sending you:

- ☐ Attached
☐ Under separate cover via _
☐ Submittals for review and comment
☐ Product data for information only

Remarks: _

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^aNote: NET = No exceptions taken; MCN = Make corrections noted; A&R = Amend and resubmit; R = Rejected
Attach additional sheets if necessary.

Contractor

Certify either a or b:

- a. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- b. ☐ We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.	Deviation

Certified by:

Contractor's Signature:

¹See Section 01 33 00-1.04. A, Transmittal Procedure.

01 75 00-A. EQUIPMENT TEST REPORT FORM

NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test report forms for this project.

BGJWSC BLW

ABC Construction Company, Inc., General Contractor
XYZ Engineering, Inc., Construction Manager

Equipment Test Report

- Equipment Name: Sludge Pump 2
- Equipment Number: P25202
- Specification Ref: 11390
- Location: East Sedimentation Basin Gallery

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
<u>A. Preoperational Checklist</u>				
1. Mechanical				
a. Lubrication				
b. Alignment				
c. Anchor bolts				
d. Seal water system operational				
e. Equipment rotates freely				
f. Safety guards				
g. Valves operational				
h. Hopper purge systems operational				
i. Sedimentation tank/hopper clean				
j. O&M manual information complete				
k. Manufacturer's installation certificate complete				
2. Electrical (circuit ring-out and high-pot tests)				
a. Circuits:				
1) Power to MCC 5				
2) Control to HOA				
3) Indicators at MCC:				
a) Red (running)				
b) Green (power)				
c) Amber (auto)				
4) Indicators at local control panel				
b. Wiring labels complete				

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
c. Nameplates:				
1) MCC				
2) Control station				
3) Control panel				
d. Equipment bumped for rotation				
3. Piping Systems				
a. Cleaned and flushed:				
1) Suction				
2) Discharge				
b. Pressure tests				
c. Temporary piping screens in place				
4. Instrumentation and Controls				
a. Flowmeter FE2502F calibration				
1) Calibration Report No.				
b. Flow recorder FR2502G calibrated against transmitter				
c. VFD speed indicator calibrated against independent reference				
d. Discharge overpressure shutdown switch calibration				
e. Simulate discharge overpressure Shutdown				
B. Functional Tests				
1. Mechanical				
a. Motor operation temperature satisfactory				
b. Pump operating temperature satisfactory				
c. Unusual noise, etc.?				
d. Pump operation: 75 gpm/50 psig				
(1) Measurement:				
(a) Flow:				
(b) Pressure:				
(c) Test gage number:				
e. Alignment hot				
f. Dowelled in				
g. Remarks:				
2. Electrical				
a. Local switch function:				
1) Runs in HAND				
2) No control power in OFF				
3) Timer control in AUTO				
b. Overpressure protection switch PS2502C functional in both HAND and AUTO				
c. Overpressure protection switch PS2502C set at 75 psig				
d. PLC 2500 set at 24-hour cycle, 25 min ON				

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

	Contractor		Construction Manager	
	Verified	Date	Verified	Date
C. Operational Test				
1.	48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional.			
RECOMMENDED FOR BENEFICIAL OCCUPANCY:				
Construction Manager			Date	
ACCEPTED FOR BENEFICIAL OCCUPANCY				
Owner's Representative			Date	

01 78 23-A. OPERATION AND MAINTENANCE TRANSMITTAL FORM

Date:	Submittal No: ²
To:	Contract No:
	Spec. Section:
	Submittal Description:
Attention:	From:

Checklist	Contractor		Construction Manager	
	Satisfactory	N/A	Accept	Deficient
1. Table of contents				
2. Equipment record forms				
3. Manufacturer information				
4. Vendor information				
5. Safety precautions				
6. Operator prestart				
7. Start-up, shutdown, and post shutdown procedures				
8. Normal operations				
9. Emergency operations				
10. Operator service requirements				
11. Environmental conditions				
12. Lubrication data				
13. Preventive maintenance plan and schedule				
14. Troubleshooting guides and diagnostic techniques				
15. Wiring diagrams and control diagrams				
16. Maintenance and repair procedures				
17. Removal and replacement instructions				
18. Spare parts and supply list				
19. Corrective maintenance man-hours				
20. Parts identification				
21. Warranty information				
22. Personnel training requirements				
23. Testing equipment and special tool information				

Remarks:

Contractor's Signature :

² See Section 01 33 00-1.04.A, Transmittal Procedure.

01 78 23-B. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

Maintenance Requirements	D	W	M	Q	S	A	Hours

Lubricants: Recommended: _____

- Alternative: _____

Misc. Notes:

Recommended Spare Parts				Electrical Nameplate Data			
Part No	Quan	Part Name	Cost	Equip			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				Hp	V	Amp	Hz
				Ph	Rpm	Sf	Duty
				Code	Insl. Cl	Des	Type
				Nema Des	C Amb	Temp Rise	Rating
				Misc.			
				Mechanical Nameplate Data			
				Equip			
				Make			
				Serial No.		Id No.	
				Model No.		Frame No.	
				Hp	Rpm	Cap	Size
				Tdh	Imp Sz	Belt No.	Cfm
				Psi	Assy No.	Case No.	
				Misc			

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

01 78 23-C. EQUIPMENT RECORD FORM

Equip Descrip		Equip Loc	
Equip No.	Shop Dwg No.	Date Inst	Cost
Mfgr		Mfgr Contact	
Mfgr Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

[illegible]

09 90 00-A COATING SYSTEM INSPECTION CHECKLIST

Project Name:

Owner:	Marietta BLW	Coating System Manufacturer (CSM)	
General Contractor (GC)		Coating System Applicator (CSA)	
Area or Structure		Location within Structure	
Coating System (e.g., E-1)		Coating Type (e.g., Epoxy, etc.)	

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
1	Completion of cleaning and substrate decontamination prior to abrasive blast cleaning.	GC QC			
		CSM QC			
		CSA QC			
2	Installation of protective enclosure of structure or area and protection of adjacent surfaces or structures that are not to be coated.	GC QC			
		CSM QC			
		CSA QC			
3	Completion of ambient condition control in structure or building area and acceptance of ventilation methods in structure or Area.	GC QC			
		CSM QC			
		CSA QC			
4	Completion of Surface Preparation for Substrates to Be Coated.	GC QC			
		CSM QC			
		CSA QC			
5	Completion of Primer Application.	GC QC			
		CSM QC			
		CSA QC			
6	Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.	GC QC			
		CSM QC			
		CSA QC			
7	Completion of Concrete Filler/ Surface Application to Concrete.	GC QC			
		CSM QC			
		CSA QC			
8	Completion of First Finish Coat Application and of Detail Treatment at Transitions or Terminations.	GC QC			
		CSM QC			
		CSA QC			

Coating System Inspection Checklist

Step	Description		Name	Signature	Date
9	Completion of Second Finish Coat Application and of Detail Treatment at Transitions and Terminations.	GC QC			
		CSM QC			
		CSA QC			
10	Completion of Full and Proper Cure of Coating System.	GC QC			
		CSM QC			
		CSA QC			
11	Completion of Testing of Cured Coating System including Adhesion, Holiday (Continuity) Testing and Dry Film Thickness.	GC QC			
		CSM QC			
		CSA QC			
12	Completion of Localized Repairs to Coating System Following Testing.	GC QC			
		CSM QC			
		CSA QC			
13	Final Acceptance of Coating System Installation Including Final Clean-Up Complying with Specification Requirements and the CSM's Quality Requirements.	GC QC			
		CSM QC			
		CSA QC			

26 05 00-A. WIRE AND CABLE RESISTANCE TEST DATA FORM

Wire or Cable No.:

Temperature, °F: _

Location of Test	Insulation resistance, megohms
1.	
2.	
3.	
4.	
5.	
6.	
7.	

.

CERTIFIED

Date _

Contractor's Representative

WITNESSED

Date _

Owner's Representative

END OF SECTION

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

DIVISION 02

EXISTING CONDITIONS

02 32 00 Geotechnical Investigation

SECTION 02 32 00
GEOTECHNICAL INVESTIGATION

PART 1 GENERAL

2.2 SUMMARY

- A. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. The Owner will not be responsible for interpretations or conclusions drawn from the data.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION

DIVISION 03

CONCRETE

03 11 00	Concrete Forming
03 20 00	Concrete Reinforcing
03 30 00	Cast-in-Place Concrete

SECTION 03 11 00
CONCRETE FORMING

PART 1 GENERAL

2.3 DESCRIPTION

- A. Formwork requirements for concrete construction.

2.4 QUALITY ASSURANCE

- A. References:

1. The references listed below are part of this section. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict, the requirements of this section shall prevail.

Reference	Title
ACI 117	Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.5	Specifications for Environmental Concrete Structures
National Institute of Standards - PS1	Construction and Industrial Plywood

- B. Design – General:

1. Provide design of formwork, shoring and reshoring systems by the Contractor's Professional Engineer currently registered in the State of the project.
2. Design, engineering, and construction of formwork, shoring, and reshoring systems is the responsibility of the Contractor.
3. Develop a procedure and schedule for removal of shores (and installation of reshores).
4. Structural record calculations, signed and sealed by the Contractor's Engineer, are required to prove that all portions of the structure, in combination with the remaining forming and shoring systems, have sufficient strength to safely support their own weight plus the loads placed thereon.
5. When developing procedures, schedules, and structural calculations; consider the structural system that exists, effects of imposed loads, and the strength of concrete at each stage of construction.

- C. Design Criteria:

1. Design formwork in accordance with ACI 301 and ACI 318 for building structures and ACI 350 and 350.5 for environmental structures to provide concrete finishes as specified in Section 03 30 00.
2. Design systems for full height of wet concrete pressure.
3. Design formwork to limit maximum deflection of form facing materials, as reflected in concrete surfaces exposed to view, to 1/240 of span.

2.5 SUBMITTALS

A. Action Submittals:

1. Procedures: Section 01 33 00.
2. Manufacturer's product data with installation instructions:
 - a. Form materials.
 - b. Form ties (with waterstops).
 - c. Form release compound.
 - d. Void forms.

B. Informational Submittals:

1. Procedures: Section 01 33 00.
2. Letter of certification:
 - a. Stating that formwork has been designed in accordance with this specification and referenced documents, sealed and stamped by the Contractor's registered design Engineer.

PART 2 PRODUCTS

2.1 FORMS

A. Wood Forms:

1. Provide new and unused exterior grade plywood panels manufactured in accordance with American Plywood Association (APA) and bearing the trademark of that group.
 - a. Forms for concrete surfaces exposed to view: use APA High Density Overlay (HDO) Plyform Class I Exterior 48-inch X 96-inch X 3/4-inch.
 - b. Forms for other concrete surfaces: use APA Douglas Fir B-B Plyform Class I Exterior 48-inch X 96-inch X 3/4-inch.
2. When approved, plywood may be reused.

B. Metal Forms:

1. Do not use aluminum. Provide forms free of rust and straight without dents to provide members of uniform thickness.

2.2 FORM TIES

- A. Commercially fabricated for use in form construction. Fabricated so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete. Cone on ends shall be 3/4-inch to 1 inch diameter. Provide embedded portion of tie not less than 1 1/2 inch from face of concrete after cone ends have been removed. Provide ties with integral waterstops at water-retaining and below grade structures.
- B. Tapered through-bolts may be used when approved. Use 1-inch minimum diameter at the smallest end. Fill tapered tie holes after cleaning to produce watertight construction. Use a mechanical waterstop plug near the center of the wall and fill each side with non-shrink cement grout. Mechanical waterstop plug shall be Greenstreak Group, Inc. "X-Plug"; or Engineer and Owner approved equal.

2.3 FORM RELEASE COMPOUND

- A. Coat form surfaces in contact with concrete using a non-staining, non-residual, water based, bond-breaking form coating.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cover surface of forms with form release compound prior to form installation in accordance with manufacturer's recommendations.
- B. Do not permit excess form coating material to stand in puddles on forms or hardened concrete surfaces against which fresh concrete is to be placed.
- C. Clean surfaces of forms, reinforcing steel and other embedded items of accumulated mortar, grout, or other foreign materials from previous concreting or construction activities before concrete is placed.

3.2 FORMWORK CONSTRUCTION

- A. Form vertical surfaces of cast-in-place concrete including sides of footings.
- B. Construct and place forms so that the resulting concrete will be of the shape, lines, dimensions, and appearance indicated on the Drawings. Brace or tie forms together to maintain position and shape under the load of freshly-placed concrete.
- C. Tighten forms to prevent leakage.
- D. Provide temporary openings (windows) at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.
- E. Provide temporary openings to limit height of free fall of concrete and to limit the lateral movement of concrete during placement. Openings are required in wall placements greater than 20 feet in height, spaced no more than 8 feet on center measured horizontally and vertically.
- F. Place a 3/4-inch chamfer strip at exposed corners of formed surfaces.
- G. At construction joints, overlap hardened concrete surface by at least 1 inch. Brace forms against hardened concrete to prevent movement, offsets, or loss of mortar at construction joint and to maintain a true surface. Where possible, locate juncture of built-in-place forms at architectural lines, control joints, or at other inconspicuous lines.
- H. Where circular sections are formed using flat faced materials, use flat form lengths not exceeding 2 feet wide and the resulting deflection angles at the joints are not greater than 3-1/2 degrees.
- I. Construct wood forms for openings to facilitate loosening. Anchor forms so that movement of any part of the formwork system is prevented during concrete placement.

- J. At platforms constructed to move equipment over in-place reinforcement, provide beams, struts, and/or legs, supported directly on formwork or other structural members without resting on reinforcing steel.
- K. Provide a positive means of adjustment (wedges or jacks) at shores and struts to take up settlement during concrete placement. Brace forms against lateral deflection. Fasten in-place wedges and shims used for final adjustment of forms prior to concrete placement.
- L. Place tapered through-bolt form ties with the larger end on the side of the structure in contact with liquid.

3.3 TOLERANCES

- A. Install formwork with tolerances in accordance with ACI 117 and the following (the more stringent requirement controls):
 - 1. Install formwork in accordance with manufacturer's written instructions.
 - 2. Vertical surface tolerance from plumb; walls, columns, piers, and risers:
 - $\pm 1/2$ inch for entire height
 - $\pm 1/4$ inch in any 10 feet of height
 - 3. Vertical surface tolerance from plumb; exposed wall corners, end columns, control-joint grooves, and other exposed to view vertical lines:
 - $\pm 1/2$ inch for entire height
 - $\pm 1/4$ inch in any 20 feet of height
 - 4. Horizontal variation from level or from grade; top of slabs, slab soffits, ceilings, and beam soffits, measured before removal of supporting shores:
 - $\pm 3/4$ -inch for entire length
 - $\pm 3/8$ inch for any bay or 20-foot length
 - $\pm 1/4$ inch in any 10 feet of length
 - 5. Horizontal variation from level or from grade; exposed lintels, sills, parapets, horizontal grooves, and other exposed-to-view horizontal lines:
 - $\pm 1/2$ inch for entire length
 - $\pm 1/4$ inch in any 20 feet of length.
 - 6. Plan position variation; columns, walls, and partitions:
 - $\pm 3/4$ -inch for entire length
 - $\pm 3/8$ inch for any bay or 20 foot length
 - 7. Plan location and size; sleeves, floor openings, walls, wall openings, beams, and columns:
 - $\pm 1/2$ inch
 - 8. Cross sectional dimensions; columns and beams and thickness of slabs and walls:
 - $\pm 3/8$ inch
 - 9. Plan dimensions; footings and foundations:
 - minus $1/2$ inch
 - + 2 inches
 - 10. Misplacement or eccentricity; footings and foundations:
 - 2 percent of footing width in direction of misplacement
 - not more than 2 inches

- 11. Thickness; footings and foundations:
 - minus 5 percent
 - no limit on the maximum increase except that which may interfere with other construction.
- 12. Step variance in flight of stairs:
 - Rise $\pm 1/16$ inch
 - Tread from level $\pm 1/8$ inch
- B. Use control points and benchmarks for reference purposes to check tolerances. Establish and maintain reference points in an undisturbed condition until final completion and acceptance of the work.
- C. Regardless of tolerances listed, no portion of a structure shall extend beyond the legal boundary of work site.
- D. Camber formwork to compensate for anticipated deflections in formwork under wet load of concrete. Adjust camber to maintain above specified tolerances in hardened concrete after forms and shoring are removed.

3.4 REMOVAL OF FORMS

- A. Do not impose construction loads or remove shoring from any part of the structure until that portion of the structure in combination with remaining forming and shoring systems has sufficient strength to safely support its weight and loads placed thereon.
- B. If forms are loosened and not removed, proceed same day with wet curing operations to soak surfaces of concrete where forms are loosened. When wet curing is not practical or not planned, loosen, remove, and start approved curing procedures on the same day.
- C. When required for concrete curing in hot weather, required for repair of surface defects, or when required for finishing at an early age; remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- D. Remove top forms on sloping surfaces as soon as concrete has attained sufficient stiffness to prevent sagging. Make repairs or finishing treatment on such sloping surfaces immediately after form removal.
- E. Remove wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- F. Remove formwork from columns, walls, sides of beams, and other parts not supporting weight of concrete as soon as concrete has hardened sufficiently to resist damage from removal.
- G. When shores and supports are so arranged such that non-load-carrying form facing material can be removed without loosening or disturbing other shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.
- H. In all cases, proceed with curing same day as form removal.

- I. Where no reshoring is planned, forms and shoring used to support weight of concrete shall be left in place until concrete has attained its specified 28-day compressive strength.

3.5 RESHORING

- A. Do not impose construction loads or remove shoring from any part of the structure until that portion of the structure, in combination with remaining forming and shoring systems, has sufficient strength to safely support its weight and loads placed thereon.
- B. While reshoring is underway, no superimposed dead or live loads are permitted on the new construction.
- C. During reshoring, do not subject concrete in structural members to combined dead and construction loads in excess of loads that the structural members can adequately support.
- D. Place reshores as soon as practicable after stripping operations are complete, but in no case later than the end of working day on which stripping occurs.
- E. Place reshores to carry their required loads without overstressing.
- F. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength specified by the formwork engineer's structural calculations and verified by field cured test cylinders or other approved method.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Section includes Reinforcing steel for use in reinforced concrete.

1.2 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements For Structural Concrete
ACI SP-66	ACI Detailing Manual
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A1064	Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
AWS D1.4	Structural Welding Code - Reinforcing Steel
CRSI-PRB	Placing Reinforcing Bars
CRSI-MSP	Manual of Standard Practice
FEDSPEC QQ-W-461H	Wire, Steel, Carbon (Round, Bare, and Coated)

1.3 SUBMITTALS

- A. Action Submittals
1. Procedures: Section 01 33 00.
 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 4. Mill certificates for all reinforcing.

5. Manufacturer and type of proprietary reinforcing steel splices. Submit a current ICC Report and manufacturer's literature that contains instructions and recommendations for each type of coupler used.
6. Qualifications of welding operators, welding processes and procedures.
7. Reinforcing steel shop drawings showing reinforcing steel bar quantities, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing steel supports. Reinforcing steel shop drawings shall be of sufficient detail to permit installation of reinforcing steel without reference to the contract drawings. Shop drawings shall not be prepared by reproducing the plans and details indicated on the contract drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of reinforcing steel, including large scale drawings at joints detailing bar placement in congested areas. Placement drawings shall be in accordance with ACI 315. Reinforcing details shall be in accordance with ACI SP-66.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Ship reinforcing steel to the jobsite with attached plastic or metal tags having permanent mark numbers which match the shop drawing mark numbers. All reinforcing shall be supported and stored above ground. Use only plastic tags secured to the reinforcing steel bars with nylon or plastic tags for epoxy coated reinforcing steel bars.

PART 2 PRODUCTS

2.1 BAR REINFORCEMENT

- A. Reinforcing steel bars shall be deformed billet steel in conformance with ASTM A615, Grade 60. Bars to be welded shall be deformed billet steel conforming to ASTM A706.

2.2 WIRE FABRIC

- A. Wire fabric shall be welded steel mesh conforming to ASTM A1064.

2.3 SMOOTH DOWEL BARS

- A. Smooth dowel bars shall conform to ASTM A615, Grade 60, with a metal end cap at the greased or sliding end to allow longitudinal movement.

2.4 REINFORCING STEEL MECHANICAL SPLICES

- A. Reinforcing steel mechanical splices shall be a positive connecting threaded type mechanical splice system manufactured by Erico, Inc., Dayton Superior, Williams Form Engineering Company, or Engineer or Owner approved equal.
- B. Mechanical splices shall develop in tension or compression a strength of not less than 125 percent of the ASTM specified minimum yield strength of the reinforcement and shall meet all other ACI 318 requirements.

2.5 TIE WIRE

- A. The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.6 BAR SUPPORTS

- A. Provide manufactured concrete block supports with or without embedded tie wires (wire dobies) for footing and slabs on grade. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
- B. Provide manufactured concrete block supports with embedded tie wires (wire dobies) for all formed surfaces where surface will be exposed to weather, water, wastewater, or soil.
- C. Provide CRSI Class 1 plastic protected or Class 2 stainless-steel protected in accordance with CRSI-MSP and placed in accordance with CRSI-PRB for all other work.

2.7 FABRICATION

- A. Fabricate reinforcing steel bars in accordance with ACI 315 and the following tolerances:
 - 1. Sheared lengths: ± 1 inch.
 - 2. Overall dimensions of stirrups, ties, and spirals: $\pm 1/2$ inch.
 - 3. All other bends: $+0$ inch, $-1/2$ inch
 - 4. Minimum diameter of bends of reinforcing steel bars: Per ACI 318.

PART 3 EXECUTION

3.1 PLACEMENT TOLERANCE

- A. Reinforcing steel placement tolerance shall conform to the requirements of ACI 117, ACI 318, and the following:
 - 1. Reinforcing steel bar clear distance to formed surfaces shall be within $\pm 1/4$ inch of specified clearance and minimum spacing between bars shall be a maximum of $1/4$ inch less than specified.
 - 2. Reinforcing steel top bars in slabs and beams shall be placed $\pm 3/8$ inch of specified depth in members 8 inches deep or less and $\pm 1/2$ inch of specified depth in members greater than 8 inches deep.
 - 3. Reinforcing steel spacing shall be placed within \pm one bar diameter or ± 1 inch, whichever is greater.
 - 4. The minimum clear distance between reinforcing steel bars shall be equal to the greater of 1 inch or the reinforcing steel bar diameter for beams, walls and slabs, and the greater of $1 1/2$ inches or 1.5 times the reinforcing steel bar diameter for columns.
 - 5. Beam and slab reinforcing steel bars shall be threaded through column vertical reinforcing steel bars without displacing the column reinforcing steel bars and still maintain clear distances for beam and slab reinforcing steel bars.

3.2 CONCRETE COVER

- A. Unless specified otherwise on the Drawings, reinforcing steel bar cover shall conform to the following:
 - 1. Reinforcing steel bar cover shall be 3 inches for concrete cast against earth.
 - 2. Reinforcing steel bar cover shall be 2 inches for reinforcing steel bars in all other areas.

3.3 SPLICING

- A. Reinforcing steel splicing shall conform to the following:
 - 1. Use splice lengths as shown on the drawings.
 - 2. Unless noted otherwise on the Drawings, splices in circumferential reinforcement in circular walls shall be staggered. Adjacent hoop reinforcement splices shall be staggered horizontally by not less than one lap length (center of lap below to center of lap above) or 3 feet, whichever is greater, and shall not coincide in vertical arrays more frequently than every third bar.
 - 3. Splicing of reinforcing elements noted as “tension tie” members on the Drawings shall be avoided whenever possible. If splices cannot be avoided, the splices shall be made with full mechanical capable of developing at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be staggered at least 30 inches.
 - 4. For welded wire fabric the splice lap length measured between the outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 inches, or less than 1.5 times the development length or less than 6 inches.
 - 5. Splices of reinforcement steel bars not specifically indicated or specified shall be subject to the approval of the Owner’s Representative. Mechanical proprietary splice connections may be used when approved by the Owner’s Representative or as indicated on the drawings.
 - 6. Welding of reinforcing steel bars is not allowed unless approved by the Owner’s Representative.

3.4 CLEANING

- A. Reinforcing steel bars at time of concrete placement shall be free of mud, oil, loose rust, or other materials that may affect or reduce bond. Reinforcing steel bars with rust, mill scale or a combination of both may be accepted without cleaning or brushing provided dimensions and weights including heights of deformation on a cleaned sample are not less than required by applicable ASTM standards.

3.5 PLACEMENT

- A. Reinforcing steel bar placement shall conform to the following:
 - 1. Reinforcing steel bars shall be supported and fastened together to prevent displacement by construction loads or concrete placement. Provide bar supports as previously prescribed.
 - 2. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, reinforcing steel bars in the upper layers shall be placed directly over the reinforcing steel bars in the bottom layer with the clear distance between each layer to be 2 inches unless otherwise noted on the Drawings. Place spacer reinforcing steel bars at a maximum of 3-foot-0-inch on center to maintain the minimum clear spacing between layers.
 - 3. Extend reinforcement to within 2 inches of formed edges and 3 inches of the concrete perimeter when concrete is placed against earth.
 - 4. Reinforcing steel bars shall not be bent after embedding in hardened concrete unless approved by the Owner’s Representative.
 - 5. Tack welding or bending reinforcing steel bars by means of heat is prohibited.

6. Where required by the contract documents, reinforcing steel bars shall be embedded into the hardened concrete utilizing an adhesive anchoring system specifically manufactured for that application. Installation shall be per the manufacturer's written instructions.
7. Bars with kinks or with bends not shown shall not be used.
8. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the Owner's Representative. Bars shall not be welded at the bend.

3.6 FIELD QUALITY CONTROL

- A. Field quality control shall include the following:
 1. Notify the Owner's Representative whenever the specified clearances between the reinforcing steel bars cannot be met. The concrete shall not be placed until the Contractor submits a solution to the congestion problem and it has been approved by the Owner's Representative.
 2. The reinforcing steel bars may be moved as necessary to avoid other reinforcing steel bars, conduits or other embedded items provided the tolerance does not exceed that specified in this section. The Engineer's approval of the modified reinforcing steel arrangement is required where the specified tolerance is exceeded. No cutting of the reinforcing steel bars shall be done without written approval of the Owner's Representative.
 3. An independent laboratory shall be employed at no additional cost to Owner to review and approve Contractor welding procedures and qualify welders in accordance with AWS D1.4. The laboratory shall visually inspect each weld for visible defects and conduct non-destructive field testing (radiographic or magnetic particle) on not less than one sample for each 10 welds. If a defective weld is found, the previous 5 welds by the same welder shall also be tested.

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

<u>Section</u>	<u>Title</u>
1.2	References
1.3	Work Included
1.4	Submittals
1.5	Quality Assurance
1.6	Delivery, Storage, and Handling
2.1	General
2.2	Concrete Materials
2.3	Forms
2.4	Reinforcement
2.5	Concrete Mix Design
3.1	Measuring Materials
3.2	Mixing and Transporting
3.3	Concrete Appearance
3.4	Placing and Compacting
3.5	Curing and Protection
3.6	Removal of Forms
3.7	Inspection and Field Testing
3.8	Concrete Finishing
3.9	Failure to Meet Requirements
3.10	Patching and Repairs
3.11	Concrete Schedule

B. Related sections

1. None.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.
- B. American Society for Testing and Materials (ASTM)
1. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
 2. C33 - Standard Specification for Concrete Aggregates
 3. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 4. C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
 5. C94 - Standard Specification for Ready-Mixed Concrete
 6. C143 - Standard Test Method for Slump of Hydraulic Cement Concrete

7. C150 - Standard Specification for Portland Cement
 8. C171 - Standard Specification for Sheet Materials for Curing Concrete
 9. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
 10. C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
 11. C260 - Standard Specification for Air-Entraining Admixtures for Concrete
 12. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 13. C494 - Standard Specification for Chemical Admixtures for Concrete
 14. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
 15. C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete
- C. American Concrete Institute (ACI)
1. ACI 304R - Guide for Measuring, Mixing, Transporting and Placing Concrete
 2. ACI 305R - Hot Weather Concreting
 3. ACI 306.1 - Standard Specification for Cold Weather Concreting
 4. ACI 318 - Building Code Requirements for Structural Concrete
 5. ACI 350R - Environmental Engineering Concrete Structures
- D. Where reference is made to one of the above Standards, the revision in effect at the time of bid opening shall apply.

1.3 WORK INCLUDED

- A. The Contractor shall, under this item, furnish all materials, tools, labor, and equipment to place all cast-in-place concrete, including all reinforcing steel and formwork, in the structures shown on the Contract Drawings, and such other concrete as may be found necessary to fully complete the Work indicated under this Contract, or as directed by the Owner.

1.4 SUBMITTALS

- A. Submit for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES all working drawings and schedules of materials and methods proposed to be followed in the execution of the Work under this item.
1. Mix Design
 - a. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type, and manufacturer of cement. Provide either 1) or 2) below for each mix proposed.
 - 1) Standard deviation data for each proposed concrete mix based on statistical records.
 - 2) The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests.

Provide the cylinder strength for the average of the 28-day cylinder strength test results for each mix. Provide results of 7- and 14-day tests.

2. Product Data
 - a. Sources of cement, Pozzolan and aggregates.
 - b. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
 - c. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM Standards.
 - d. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - e. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
 - f. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
 - g. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM Standards. Identify proposed locations of use.
3. Samples
 - a. Fine and coarse aggregates if requested by the Engineer.
4. Certificates
 - a. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
 - b. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
 - c. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).
5. Test and Evaluation Reports
 - a. Fine aggregates – sieve analysis, physical properties, and deleterious substance.
 - b. Coarse aggregates – sieve analysis, physical properties, and deleterious substances.
 - c. Cements – chemical analysis and physical properties for each type.
 - d. Pozzolans – chemical analysis and physical properties.
 - e. Proposed concrete mixes – compressive strength, slump and air content.
 - f. Shrinkage Test Results – In accordance with ASTM C157 as modified hereinafter.
6. Field Quality Control Submittals
 - a. Field test reports.
 - b. Concrete Delivery/Batch Tickets:
 - 1) For each batch of concrete before unloading at Site.
 - 2) In accordance with ASTM C94/C94M, Section 14 including requirements. 14.2.1 through 14.2.10.
 - 3) Indicate the amount of mixing water withheld, and maximum amount that may be permitted to be added at Project Site.

7. Special Procedure Submittals

- a. Detailed plan for cold weather curing and protection of concrete placed and cured in weather below 40 degrees F.
- b. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F.
- c. If Contractor chooses to use self-consolidating concrete: Detailed plan of modified procedures for handling, placing, and finishing.

1.5 QUALITY ASSURANCE

- A. Comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes, and standards. The most stringent requirement of the codes and standards and this Section apply when conflicts exist.
- B. Use only one source of cement and aggregates on any one structure. Provide concrete of uniform color and appearance.
- C. A minimum of 14 days in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Discuss the properties and techniques of batching and placing plasticized concrete prior to the placement of any concrete containing a high-range water-reducing admixture (plasticizer). Include the plasticizer manufacturer in the discussions.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. Make all changes ordered at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, provide all materials, labor, and equipment, at the Contractor's expense, necessary to perform new acceptance tests as were originally required using the new materials prior to their incorporation in the work. If the tests are specified to be conducted by others, the costs of these tests shall be borne solely by the Contractor.
- F. Qualifications
 1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or an approved equivalent program.
 2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in the jurisdiction of the Work. Requirements may be waived if the individual is Contractor's Licensed Design Engineer.
 3. Installers: Unless otherwise permitted, at least one person on the finishing crew must be certified as an ACI Flatwork Finisher, or equivalent.

G. Preconstruction Testing

1. Have the following materials tested to verify conformity with this Specification Section and the stated ASTM Standards.
 - a. Fine aggregates for conformity with ASTM C33 – sieve analysis, physical properties, and deleterious substances.
 - b. Coarse aggregates for conformity with ASTM C33 – sieve analysis, physical properties, and deleterious substances.
 - c. Cements for conformity with ASTM C150 – chemical analysis and physical properties.
 - d. Pozzolans for conformity with ASTM C618 – chemical analysis and physical properties.
 - e. Proposed concrete mix designs – compressive strength, slump and air content.

H. Field Samples

1. Field testing and inspection services will be provided by the Contractor. The Contractor will pay the cost of such work, except as specifically stated otherwise. The Contractor will test the following items to verify conformity with this Specification Section.
 - a. Concrete placements – compressive strength (cylinders), compressive strength (cores), slump, and air content.
 - b. Other materials or products that may come under question.
2. Confirm all materials incorporated in the work to accepted samples.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements

1. Cement: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination and to minimize warehouse set.
2. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.
3. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to a uniform moisture content before using. Do not use frozen or partially frozen aggregates.
4. Admixtures: Store in closed containers to avoid contamination, evaporation, or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
5. Pozzolan: Store in weathertight buildings, bins, or silos to provide protection from dampness and contamination.
6. Sheet Curing Materials: Store in weathertight buildings or off the ground and under cover.
7. Liquid Curing Compounds: Store in closed containers.

PART 2 PRODUCTS

2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired. Such reference is not intended to indicate a restrictive preference on the part of the Owner for that particular manufacturer or product, or to prohibit the use of equivalent products or Engineer and Owner approved equally qualified manufacturers.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance, and manufacturer's service.

2.2 CONCRETE MATERIALS

- A. Cementitious Materials
 - 1. Portland Cement
 - a. In accordance with requirements of ASTM C150.
 - b. Brand: Subject to approval of Engineer. Use one brand throughout the Work.
 - c. Alkalies: Maximum 0.60 percent.
 - d. Nonhydraulic above grade structures: Type I or Type II.
 - e. Hydraulic and below grade structures and sewers: Type II
 - 2. Supplementary Cementitious Materials
 - a. Fly Ash (Pozzolan): Class F or Class N fly ash in accordance with ASTM C618, except as modified herein:
 - 1) Produced from process that does not use hazardous or potentially hazardous materials.
 - 2) ASTM C618, Table 1, Loss on Ignition: Maximum 3 percent.
 - 3) ASTM C618, Table 2, Water Requirement: Maximum 100 percent of control.
 - 4) ASTM C618, Table 3, Effectiveness in Controlling Alkali-Silica Reaction: Maximum 100 percent expansion of test mixture as a percentage of low-alkali cement control at 14 days.
 - 5) ASTM C618, Table 3, Expansion of Test Mixture: Evaluate results using either Procedure A or Procedure B as follows:
 - a) Procedure A after 6-month sulfate exposure, maximum 0.10 percent.
 - b) Procedure B, expansion of test mixture as a percentage of sulfate resistance cement control, after at least 6-month exposure, maximum 100 percent.
 - 6) Where fly ash is specified to be used with Type I cement, have fly ash meet one of the following requirements:
 - a) CaO: Maximum 15 percent.
 - b) Test cementitious materials as follows:
 - (1) In accordance with ASTM C1012.
 - (2) Furnish test data confirming fly ash in combination with cement used meets strength requirements, is compatible with air-entraining agents and other additives, provides increased sulfate resistance equivalent to or better than Type II cement.

- (3) Conduct tests using proposed fly ash and cement samples together with control samples using Type II cement without fly ash.
 - b. Slag Cement: In accordance with ASTM C989, Grades 100 or 120.
- 3. Tricalcium Aluminate
 - a. Content of Cementitious Materials: Maximum 8 percent.
- B. Aggregates: Furnish from one source.
 - 1. Natural Aggregates
 - a. Free from deleterious coatings and substances and conforming to requirements of ASTM C33, except as modified herein.
 - b. Free from materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - 2. Nonpotentially Reactive: In accordance with ASTM C33, Appendix XI, Paragraph X1.1.
 - 3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.
 - 4. Fine Aggregates
 - a. Clean, sharp, and natural sand.
 - b. ASTM C33.
 - c. Material Passing 200 Sieve: 4 percent maximum.
 - d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 20 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
 - 5. Coarse Aggregates
 - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
 - b. Materials Passing 200 Sieve: 0.5 percent maximum.
 - c. Limit deleterious substances in accordance with ASTM C33, Table 3 for exposed concrete.
- C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.
 - 1. Characteristics
 - a. Compatible with other constituents in mix.
 - b. Free of chlorides and alkalis (except for those attributable to water).
 - c. Do not use admixtures known to be toxic after concrete has been cured for 30 days.
 - d. Furnish type of admixtures as recommended by manufacturer for anticipated temperature ranges.
 - e. Proportion and mix in accordance with manufacturer's recommendations.
 - 2. Air-Entraining Admixture: ASTM C260
 - 3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - 4. Retarding Admixture: ASTM C494/C494M, Type B.
 - 5. High Range Water Reducing Admixture (Superplasticizer): ASTM C494/C494M, Type F or G. Use only when approved by Engineer.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II. Use only when approved by Engineer.
 - a. Use of viscosity modifier if intent is to achieve self-consolidating concrete.

7. Do not use calcium chloride as an admixture.
- D. Water and Ice: Use potable water for mixing water for concrete and water used to make ice unless alternative sources of water are permitted.
 1. Water from alternative sources: Comply with requirements of ASTM C1602/C1602M and contain less than:
 - a. 1,000 ppm of chlorides.
 - b. 3,000 ppm sulfate as SO_4 .
 - c. 600 ppm alkalis as $(\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O})$.
 - d. 50,000 ppm total solids by mass.

2.3 FORMS

- A. The Contractor shall furnish all labor and materials for all forms required for the construction of the Work.
- B. Either metal or wood forms may be used.
- C. All forms shall be true to the required shape, clean, of sufficient strength, and well braced so that they shall maintain their proper position during the placing and vibrating of the concrete.

2.4 REINFORCEMENT

- A. All steel reinforcement bars, wire, and dowel bars shall be in accordance with section 03 20 00.
- B. Steel reinforcement shall be designed, detailed, fabricated and placed in conformance with all applicable requirements of ACI 318, and the CRSI Manual of Standard Practice.
- C. No concrete shall be placed until all steel reinforcement to be covered has been inspected in place and approved by the Owner or the Engineer.

2.5 CONCRETE MIX DESIGN

- A. Use an independent testing laboratory acceptable to the Engineer for development of mix designs and testing.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper workability, durability, strength, appearance, and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. Base the design mix on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318.

- D. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7- and 28-day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- E. Compression Tests: Contractor to provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraphs.
- F. Entrained air, as measured by ASTM C231, as shown in Table 1.
1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- G. Slump of the concrete as measured by ASTM C143, as shown in Table 1. If a high-range water-reducer (plasticizer) is used, measure the slump before plasticizer is added. Plasticized concrete shall have a slump ranging from 7 to 10 inches.
- H. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

Table 1. Concrete Mix Requirements

Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
B	2,500	C150 Type II	C33	57	440 min.
A	3,000	C150 Type II	C33	57	480 min.
AA	4,000	C150 Type II	C33	57	560 min.
E	2,000	C150 Type II	C33	57	-

Table 1. Concrete Mix Requirements

Class	W/C Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range, Inches
B	0.62 max	--	3.5 to 5	Yes	*	1-4
A	0.54 max	--	3.5 to 5	Yes	*	1-3
AA	0.44 max	25 percent	3.5 to 5	Yes	*	3-5
E (9)	-	--	Not Required	Yes	*	4-8

NOTES:

1. Minimum compressive strength in psi at 28 days
2. ASTM designation
3. Size Number in ASTM C33
4. Cementitious content in lb./cu yd
5. W/C is Water-Cementitious ratio by weight
6. AE is percent air-entrainment
7. WR is water-reducer admixture
8. HRWR is high-range water-reducer admixture
*HRWR used at contractor's option
9. Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.

PART 3 EXECUTION

3.1 MEASURING MATERIALS

- A. Compose concrete of Portland cement, fine aggregate, coarse aggregate, water and admixtures as specified. Use a batch plant acceptable to the Engineer for concrete production. Batch all constituents, including admixtures, at the plant except a high-range water-reducer may also be added in the field.
- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Have scales certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.
- D. Dispense admixtures either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 2. Inject multiple admixtures separately during the batching sequence.

3.2 MIXING AND TRANSPORTING

- A. Provide ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck

- with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- B. Transport ready-mix concrete to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
 - C. Keep the water tank valve on each transit truck locked at all times. Any addition of water must be directed by the Engineer. Incorporate added water by additional mixing of at least 35 revolutions. Meter all added water with the amount of water added shown on each delivery ticket.
 - D. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
 - E. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Use metal or metal-lined non-aluminum discharge chutes with slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
 - F. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
 - G. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
 - H. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Provide a printed record of the weight of cement and each aggregate as batched individually on each ticket. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
 - I. Temperature and Mixing Time Control
 1. In cold weather, do not allow the as-mixed temperature and concrete temperature at the time of placement in the forms to drop below 40 degrees F.
 2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
 3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
 4. Do not exceed the values shown in Table 2 for the maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms.

Table 2. Maximum Time to Discharge Of Concrete

Air or Concrete Temperature (whichever is greater)	Maximum Time
80 to 90 Degrees F (27 to 30 Degrees C)	45 Minutes
70 to 79 Degrees F (21 to 26 Degrees C)	60 Minutes
40 to 69 Degrees F (5 to 20 degrees C)	90 Minutes

^a. If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.3 CONCRETE APPEARANCE

- A. Remix concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste. If this does not correct the condition, reject the concrete. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, obtain changes in the concrete mix only by adjusting one or more of the following:
 - 1. The gradation of aggregate.
 - 2. The proportion of fine and coarse aggregate.
 - 3. The percentage of entrained air, within the allowable limits.
- B. Provide concrete for the work that results in a homogeneous structure which, when hardened, will have the required strength, durability, and appearance. Provide mixtures and workmanship such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10-ft away, shall be pleasing in appearance, and at 20-ft shall show no visible defects.

3.4 PLACING AND COMPACTING

- A. Placing
 - 1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt, and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
 - 2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.
 - 3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
 - 4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.

5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.
 6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
 7. Slabs
 - a. After suitable bulkheads, screeds and jointing materials have been positioned, place the concrete continuously between construction joints beginning at a bulkhead, edge form, or corner. Place each batch into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in casting. If there is a delay in casting, thoroughly spade and consolidate at the edge of that previously placed and the concrete placed after the delay to avoid cold joints. Then bring concrete to correct level and strike off with a straightedge. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows.
 - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.
 8. Formed Concrete
 - a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-inch lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 7-ft and the maximum free fall of concrete not exceeding 15-ft.
 9. Perform underwater concreting in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Use tremie pipes in the range of 8 to 12 inches in diameter and space at not more than 16-ft on centers nor more than 8-ft from an end form. Where concrete is being placed around a pipe, provide at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system including details by the Engineer.
- B. Compacting
1. Consolidate concrete by vibration, puddling, spading, rodding, or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Continuously perform puddling, spading, etc., along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.
 2. Place and compact all concrete with mechanical vibrators. Obtain approval of the number, type, and size of the units from the Engineer in advance of placing operations. Do not order concrete until sufficient approved vibrators (including standby units in working order) are on the job.
 3. A minimum frequency of 7,000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30 inches apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not

overvibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.

4. Concrete Slabs: Consolidate concrete for slabs less than 8 inches thick with vibrating screeds; slabs 8 to 12-in thick with internal vibrators and (optionally) with vibrating screeds. Always place vibrators into concrete vertically and do not lay horizontally or over.
5. Walls and Columns: Use internal vibrators (rather than form vibrators) unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize, and perfect the surface. Insert the vibrators vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete. Do not use vibrators to move or transport concrete in the forms. Continue vibration until:
 - a. Frequency returns to normal.
 - b. Surface appears liquefied, flattened and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into surface but has not disappeared.

3.5 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
 1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Use the following curing methods.
 - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
 - b. 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.
 - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Apply curing compound as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Comply with the manufacturer's application recommendations.
 2. Specified applications of curing methods.
 - a. Slabs for Water Containment Structures: Water curing only.
 - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.
 - c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.

- d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
 - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Water cure exposed horizontal surfaces of formed walls or columns for 7 days or until next placement of concrete is made.
 - f. Concrete Joints: Water cured, or sheet material cured.
- C. Protect finished surfaces and slabs from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
 - 1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. Calculate the average daily temperature as the average of the highest and the lowest temperature during the period from midnight to midnight.
 - 2. Conform cold weather concreting to ACI 306.1 and the additional requirements specified herein. Record temperatures at the concrete placement at 12-hour intervals (minimum).
 - 3. Discuss a cold weather work plan with the Engineer. Discuss the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. Also discuss the procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Do not begin cold weather concreting until the work plan is acceptable to the Engineer. Approval of the work Plan by the Engineer shall not relieve the Contractor of their sole responsibility for the quality of the concrete work produced.
 - 4. During periods of cold weather, protect concrete to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
 - a. Degree-days are defined as the total number of 24-hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (e.g., 5 days at an average 70 degrees F = 350 degree-days).
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
 - 5. Salt, manure, or other chemicals shall not be used for protection.
 - 6. Do not terminate the protection period for concrete being water cured during cold weather until at least 24 hours after water curing has been terminated.
- E. Hot Weather Concreting
 - 1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lb./sq ft/hr.

2. Concrete placed during hot weather shall be batched, delivered, placed, cured, and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
 - a. Do not exceed 90 degrees F for the temperature of concrete being placed. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.
 - b. Take all necessary precautions to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. Provide the Engineer with a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Do not begin hot weather concreting until the work plan is acceptable to the Engineer. Approval of the work plan by the Engineer shall not relieve the Contractor of their sole responsibility for the quality of the concrete work produced.

3.6 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, do not remove forms before the concrete has attained a strength of at least 30 percent of its specified design strength, nor before reaching the following number of day-degrees of curing (whichever is the longer):

Table 3. Minimum Time to Form Removal

Forms for	Degree Day
Beams and slabs	500
Walls / Vertical surfaces	100

(See definition of degree-days in Paragraph 3.5.D above).

- B. Do not remove shores until the concrete has attained at least 70 percent of its specified design strength and has achieved sufficient strength to support safely its own weight and construction live loads.

3.7 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing, and curing of concrete are subject to the inspection of the Engineer at all times. Advise the Engineer of readiness to proceed at least 24 hours prior to each concrete placement. The Engineer or the Owner will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness, and tightness of formwork. Do not place concrete without the inspection and acceptance of the Engineer or the Owner.
- B. Sets of field control cylinder specimens will be taken by the Engineer or the Owner Materials Testing Representative during the progress of the work, in compliance with ASTM C31. Take a minimum of one set of concrete test cylinders per day, one set for

each 150 cubic yards of concrete, or one set for each 5,000 sq ft of surface area for slabs or walls of each class of concrete placed each day.

1. A "set" of test cylinders consists of five cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The other two may be used for special tests at 3 days or to verify strength after 56 days if 28-day test results are low.
 2. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7-day strengths (where proper relation between seven and 28-day strengths have been established by tests), change proportions, water content, or temperature conditions to achieve the required strengths.
- C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations, and furnish material and labor required for the purpose of taking concrete cylinder samples. Provide an appropriate number of curing boxes acceptable to the Engineer.
- D. Slump tests will be made in the field immediately prior to placing the concrete. Make such tests in accordance with ASTM C143. Reject concrete if the slump is greater than the specified range.
- E. Air Content: Test for air content shall be made on a fresh concrete sample. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173. If lightweight aggregates or aggregates with high absorptions are used, the latter test method shall be used.
- F. 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 tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- G. 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. Perform coring and collect core samples at the locations indicated by the Engineer and repair all core holes. The testing of the cores will be at the expense of the Contractor. The Contractor will pay for collection and repair of cores if the test results meet the required specifications.

3.8 CONCRETE FINISHING

- A. Walls
1. Type W-1 (Ordinary Wall Finish)
 - a. Patch tie holes.
 - b. Surface tolerance Class C as specified in ACI 117.
 - c. Knock off projections larger than 1/2-inch.
 - d. Patch defective areas.
 2. Type W-2 (Smooth Wall Finish)
 - a. Patch tie holes.

- b. Surface tolerance Class B as specified in ACI 117.
- c. Grind off projections larger than 1/4-inch.
- d. Patch defective areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.
- 3. Type W-3 (Smooth Rubbed Wall Finish)
 - a. Surface tolerance Class A as specified in ACI 117.
 - b. Remove projections larger than 1/8-inch.
 - c. Only water curing will be permitted on walls being rubbed.
 - d. Perform rubbing while green concrete can be physically worked and smoothed without adding other materials, if structurally possible, the day following placement. Finish no later than 3 days after placement has been completed.
 - e. Remove forms at such a rate that finishing, form tie filling, removal of projections, and patching can be completed on same day forms are removed while curing wall.
 - f. After pointings have set sufficiently to permit working on surface, thoroughly saturate entire surface with water for period of 3 hours and rub until uniform surface is obtained.
 - g. Rub either by hand with carborundum stone of medium-coarse grade or abrasive of equal quality, or mechanically operated carborundum stone.
 - h. Obtain Engineer approval of mechanically operated carborundum stones before concrete finishing.
 - i. Do not use cement grout, other than cement paste drawn from the concrete itself by rubbing process.
 - j. Finishing past formed by rubbing by either brushing or floating as follows:
 - 1) Brushing:
 - a) Carefully strike with clean brush.
 - b) Brush in long direction of surface being finished.
 - 2) Floating:
 - a) Spread uniformly over surface and allow to reset.
 - b) Finish by floating with canvas, carpet face, or cork float, or rub down with dry burlap.
 - k. Continue water curing of wall during finishing operation in areas not being rubbed.
 - l. Move water curing onto rubbed areas as soon as water will not erode rubbed surface.

B. Slabs

- 1. General
 - a. Finish slab concrete per the requirements of ACI 302.1R.
 - b. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
 - c. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer or mortar, which will be weak and cause cracks or delamination, to accumulate.
 - d. Do not dust surface with dry materials.

- e. Use evaporation retardant.
 - f. Round off edges of slabs with steel edging tool, except where cove finish is shown. Use a steel edging tool with a 1/4-inch radius for slabs subject to wheeled traffic.
2. Type S-1 (Steel Troweled Finish)
- a. Finish by screeding and floating with straightedges to bring surfaces to required finish elevation. Use evaporation retardant.
 - b. While concrete is still green, but sufficiently hardened to bear a person's weight without deep imprint, wood float to true, even plane with no coarse aggregate visible.
 - c. Use sufficient pressure on wood floats to bring moisture to surface.
 - d. After surface moisture has disappeared, hand trowel concrete to produce smooth, impervious surface, free from trowel marks.
 - e. Burnish surface with an additional troweling. Final troweling shall produce ringing sound from trowel.
 - f. Do not use dry cement or additional water during troweling, nor will excessive troweling be permitted.
 - g. Power Finishing:
 - 1) Approved power machine may be used in lieu of hand finishing in accordance with directions of machine manufacturer.
 - 2) Do not use power machine when concrete has not attained necessary set to allow finishing without introducing high and low spots in slab.
 - 3) Do first steel troweling for slab S-1 finish by hand.
3. Type S-2 (Wood Float Finish)
- a. Finish slab to receive fill and mortar setting bed by screeding with straight-edges to bring surface to required finish plane.
 - b. Wood float finish to compact and seal surface.
 - c. Remove laitance and leave surface clean.
 - d. Coordinate with other finish procedures.
4. Type S-3 (Underside Elevated Slab Finish)
- a. When forming is removed, grind off projections on underside of slab and patch defective areas.
5. Type S-4 (Broomed Finish)
- a. Finish as specified for Type S-1 floor finish, except omit final troweling and finish surface by drawing fine-hair broom lightly across surface.
 - b. Broom in same direction and parallel to expansion joints, or, in the case of inclined slabs, perpendicular to slope, except for round roof slab.
6. Type S-5 (Sidewalk Finish)
- a. Slope sidewalk down 1/4-inch per foot away from structures, unless otherwise shown.
 - b. Strike off surface by means of strike board and float with wood or cork float to true plane, then flat steel trowel before brooming.
 - c. Broom surface at right angles to direction of traffic or as shown.
 - d. Lay out sidewalk surface in blocks, as shown or as directed by Engineer, with grooving tool.

C. Beams and Columns

1. General: Inject cracks with crack repair epoxy. Patch and repair defective areas.
2. Type B-1: Match wall Type W-1.
3. Type B-2: Match wall Type W-2.
4. Type B-3:
 - a. Repair rock pockets.
 - b. Fill air voids.
 - c. Match wall Type W-3.
5. Type C-1: Match wall Type W-1.
6. Type C-2: match wall Type W-2.
7. Type C-3:
 - a. Repair rock pockets.
 - b. Fill air voids.
 - c. Match wall Type W-3.

3.9 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer has the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer has 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 has 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 such cases of failure to meet strength requirements confer with the Engineer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified 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 the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.
- D. Any concrete found to be defective from any cause whatsoever, at any time prior to Final Acceptance of the Work, shall be removed and replaced, or repaired at the expense of the Contractor.

3.10 PATCHING AND REPAIRS

- A. It is the intent of this Section to require quality work, including adequate forming, proper mixture and placement of concrete and curing, so completed surfaces will require no patching.
- B. Repair defective concrete and honeycombed areas using methods complying with industry standards which meet the approval of the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, remove fins and other projections; fill recesses left by the removal of form ties; and repair surface defects which do not impair structural strength. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.
- D. Immediately after removal of forms remove plugs and break off metal ties. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-in 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 (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- E. When patching exposed surfaces use the same source of cement and sand as used in the parent concrete. Adjust color if necessary, by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.11 CONCRETE SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

Table 4. Concrete Schedule

Class	Design Strength (psi)	Description
A	3,000	Thrust blocking, slabs, curbs, fence post encasement, and pavements,
AA	4,000	Walls, beam systems, columns, and all other structural concrete
E	2,000	Pipe bedding and encasement, electrical conduit encasement (duct banks), and concrete fill.

END OF SECTION

DIVISION

05 METALS

05 05 13.13	Zinc Coatings
05 05 20	Anchor Bolts

SECTION 05 05 13.13
ZINC COATINGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section specifies both hot-dip zinc coating and mechanical zinc coating. Electroplated corrosion protection is not an acceptable substitute for mechanical zinc coating.

1.2 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A780	Repair of Damaged Hot-Dip Galvanized Coatings
ASTM B695	Coatings of Zinc Mechanically Deposited on Iron and Steel
MILSPEC DOD-P-21035	Paint, High Zinc Dust Content, Galvanizing Repair

1.3 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
1. Zinc dust-zinc oxide coating manufacturer's product data showing conformance to the specified product.
 2. Manufacturer's recommendation for application of zinc dust-zinc oxide coating.

3. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements of ASTM A123 or A153, as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Zinc Coating:
 1. Hot-dip zinc coating material shall be as specified in ASTM A123 and A153, as applicable. Mechanical zinc coating shall be as specified in ASTM B695.
- B. Zinc Dust-Zinc Oxide Coating:
 1. Zinc dust-zinc oxide coating shall conform to MILSPEC DOD-P-21035. Coating shall be as manufactured by Z.R.C. Chemical Products Co., Galvicon Co., or Engineer and Owner approved equal.

2.2 FABRICATION REQUIREMENTS

- A. Fabrication practices for products to be galvanized shall be in accordance with applicable portions of ASTM A143, A384 and A385.

PART 3 EXECUTION

3.1 APPLICATION

- A. Steel members, fabrications and assemblies shall be galvanized after fabrication in accordance with ASTM A123.
- B. Structural steel connection bolts, screws, nuts, washers shall be hot-dip galvanized per ASTM A153.

3.2 COATING REQUIREMENTS

- A. Hot-dip coating weight shall conform to paragraph 5.1 of ASTM A123 or Table 1 of ASTM A153, as appropriate.
- B. Mechanically applied coating thickness shall be Class 50 as specified in ASTM B695.

3.3 REPAIR OF DEFECTIVE GALVANIZED COATING

- A. Where zinc coating has been damaged after installation, substrate surface shall be first cleaned and then repaired with zinc dust-zinc oxide coating in accordance with ASTM A780. Application shall be as recommended by the zinc dust-zinc oxide coating manufacturer. Coating shall consist of multiple coats to dry film thickness of 8 mils.
- B. Items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, shall be removed from the project site for repair by the hot-dip zinc coating method.

END OF SECTION

SECTION 05 05 20
ANCHOR BOLTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Bolts and all-thread rods used to attach structural elements and equipment to concrete. Included are cast-in-place and post-installed anchors (adhesive systems and wedge type expansion anchors), nuts and washers.
- B. Cast-in-place and post-installed anchors shall be Type 316 stainless-steel unless noted otherwise.

1.2 REFERENCES

- A. The references listed below are a part of this section. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ACI 318	Building Code Requirements for Structural Concrete
ASTM A193	Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
ASTM A194	Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A320	Alloy-Steel and Stainless-Steel Bolting for Low-Temperature Service
ASTM A563	Carbon and Alloy Steel Nuts
ASTM F593	Stainless-steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless-steel Nuts
ASTM F844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F1554	Anchor Bolts, Steel, 36, 55, 105-ksi Yield Strength
IBC	International Building Code with local amendments

1.3 SUBMITTALS

- A. Action Submittals
 - 1. Procedures: Section 01 33 00.
 - 2. A copy of this specification section with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - 3. Check-marks (✓) shall denote full compliance with a paragraph as a whole. Deviations shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Include a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested

deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

4. Anchor bolt placement plans.
5. Anchor bolt, nut, and washer material information, including material certifications.
6. Record copy of design calculations and details showing the required diameter, length, embedment, edge distance, confinement, anchor reinforcement, anchor bolt sleeves, connection redesign, and other conditions, stamped and signed by a Professional Engineer currently registered in the state of Georgia.
7. Product Data:
 - a. ICC Evaluation Service Reports for post-installed adhesive type anchors and expansion (wedge type) anchors when allowed. Products shall be ICC approved for use in cracked concrete in high seismic areas (Seismic Design Category D, E and F).
 - b. Product data indicating load capacity charts/calculations.
 - c. Chemical resistance.
 - d. Temperature limitations.
 - e. Manufacturers written installation instructions.
8. Installer certification for horizontal or upwardly inclined adhesive anchors in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program.

1.4 QUALITY ASSURANCE

A. Quality Assurance by Owner

1. Special inspection of anchor bolts shall be performed by the Special Inspector under contract with the Owner and in accordance with IBC Chapter 17.
2. Adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads shall be continuously inspected during installation by a Special Inspector.
3. The Special Inspector shall furnish a report to the Engineer, Owner's Representative, and Building Official that the work covered by the report has been performed and that the materials used, and the installation procedures used conform with the approved Project Manual and the Manufacturer's Printed Installation Instructions (MPII).

B. Certifications

1. Installer certification shall be in accordance with ACI/CRSI Adhesive Anchor Installer Certification Program for installers of horizontal or upwardly inclined adhesive anchors.

PART 2 PRODUCTS

2.1 GENERAL

- A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 1/4 inch. Minimum anchor bolt diameter shall be 1/2 inch.
- B. Tapered washers shall be provided where mating surface is not square with the nut.

- C. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings. Substitution of post-installed anchors will not be permitted unless specifically requested by the Contractor and approved by the Engineer.

2.2 PERFORMANCE/DESIGN CRITERIA

- A. Anchor bolts for equipment shall be designed by the equipment manufacturer to include equipment operational loads combined with seismic and wind forces when applicable.

2.3 MATERIALS

- A. Anchor bolt materials shall be as specified in the following table:

Material	Specification
Stainless-steel Anchor Bolts	ASTM A193 or A320, Type 316
Stainless-steel Threaded Rods	ASTM F593, Type 316
Stainless-steel Nuts and Washers	ASTM A194 Heavy Hex Nuts and Washers, Type 316 ASTM F594 Heavy Hex Nuts at Adhesive Anchors, Type 316
Carbon Steel Anchor Bolts	ASTM F1554, Grade 36, Hot Dip Galvanized
High-Strength Carbon Steel Anchor Bolts	ASTM F1554, Grade 55, Weldable per Supplementary Requirement S1, Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and F844, Heavy Hex, Hot-Dip Galvanized
Concrete Adhesive Anchors	Hilti "HIT-RE 500-SD", Simpson "SET-XP", or approved engineer approved equivalent, with Type 316 Stainless-steel threaded rods
Masonry Adhesive Anchors	Hilti "HIT-HY 70", Simpson "SET", or approved engineer approved equivalent, with Type 316 Stainless-steel threaded rods
Masonry Expansion (wedge) Anchors*	Hilti "KWIK BOLT 3-inch, or approved engineer approved equivalent, Type 316 Stainless-steel
Concrete Expansion (wedge) Anchors*	Hilti "KWIK BOLT TZ", or approved engineer approved equivalent, Type 316 Stainless-steel

* Post installed anchors shall always be an adhesive type anchor system except where noted otherwise or when Contractor makes a request for a specific application and Engineer approves.

2.4 STAINLESS-STEEL FASTENER LUBRICANT (ANTI-SEIZING)

- A. Anti-seizing Lubricant for Stainless-steel Threaded Connections:
1. Formulated to resist washout.
 2. Acceptable manufacturers are Bostik, Saf-T-Eze, or engineer and owner approved equivalent.

2.5 ANCHOR BOLT SLEEVES

- A. Provide anchor bolt sleeves as shown on design drawings and as required by equipment manufacturer's design.
1. Provide high density polyethylene plastic sleeves of single unit construction with deformed sidewalls such that the concrete and grout lock in place.
 2. The top of the sleeve shall be self-threading to provide adjustment of the threaded anchor bolt projection.
 3. Acceptable manufacturers are Contec, Wilson, or engineer and owner approved

equivalent.

PART 3 EXECUTION

3.1 GENERAL

- A. Anchor bolts shall be cast-in-place anchors unless post-installed anchors are specified or shown on the Drawings.
- B. The threaded end of anchor bolts and all-thread rods shall be long enough to project through the entire depth of the nut and if too long, shall be cut off at ½-inch beyond top of nut and ground smooth.

3.2 CAST-IN-PLACE ANCHOR BOLTS

- A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position using templates while the concrete is placed.
- B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.3 ADHESIVE ANCHOR BOLTS

- A. Note that adhesive anchors shall not be substituted for cast-in-place anchor bolts unless the adhesive anchors have been specified or shown on the Drawings, or approval has been obtained from the Engineer that substitution of adhesive anchors is acceptable for the specific use and location. Use of adhesive anchors shall be subject to the following conditions:
 - 1. Limit to locations where intermittent or continuous exposure to the following is extremely unlikely:
 - a. Acid concentrations higher than 10 percent
 - b. Chlorine gas
 - c. Machine or diesel oils
 - 2. Limit to applications where exposure to the following is extremely unlikely:
 - a. Fire
 - b. Concrete or rod temperature above 120 degrees F
 - 3. Overhead applications (such as pipe supports) shall not be allowed unless approved by the Engineer and installation is by an Installer specially certified for overhead applications.
 - 4. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
 - 5. Anchor diameter and material shall be per Contract Documents or equipment manufacturer's specifications. Anchor shall be threaded or deformed the full length of embedment and shall be free of rust, scale, grease, and oils.
 - 6. Embedment depth shall be as specified or as required by the equipment manufacturer.
 - 7. Follow the anchor system manufacturer's installation instructions.
 - 8. Holes shall have rough surfaces created by using a hammer drill with carbide bit. Core drilled holes are not allowed.

9. Holes shall be blown clean with oil-free compressed air and be free of dust or standing water prior to installation. Follow additional requirements of the adhesive manufacturer.
10. Concrete and air temperature shall be compatible with curing requirements of adhesives per adhesive manufacturer's instructions. Anchors shall not be placed in concrete when the temperature is below 25 degrees F.
11. Anchors shall be left undisturbed and unloaded for full adhesive curing period, which is based on temperature of the concrete.

3.4 EXPANSION ANCHORS

- A. Expansion (wedge type) anchors shall not be substituted for cast-in-place anchor bolts or adhesive anchors unless approved by the Engineer for a specific application. Use of expansion anchors shall be subject to conditions 4 through 9 as specified above for adhesive anchors. Expansion anchors shall not be used in a submerged condition or in mounting of equipment subject to vibration or cyclic motion.

3.5 REINFORCING STEEL CONFLICTS WITH POST-INSTALLED ANCHOR INSTALLATION

- A. When reinforcing steel is encountered in the drill path, slant drill to clear obstruction and provide beveled washer to match angle of anchor. Drill shall not be slanted more than 10 degrees.
- B. Where slanting the drill does not resolve the conflict, notify the Owner's Representative, and resolve the conflict to the satisfaction of the Owner's Representative in consultation with the Engineer.
- C. Abandoned post-installed anchor holes shall be cleaned and filled with non-shrink grout and struck off flush with adjacent surface.
- D. The costs of determining and executing the resolution shall be borne by the Contractor. The determination and execution of the resolution shall not result in additional cost to the Owner.

END OF SECTION

DIVISION 09

FINISHES

09 90 00 Painting and Coating Systems

SECTION 09 90 00
PAINTING AND COATING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section specifies coating systems, surface preparations, and application requirements for coating systems.

B. Definitions:

1. Specific coating terminology used in this Section is in accordance with definitions contained in ASTM D16, ASTM D3960, and the following definitions.

a. Definitions:

- 1) Abrasive: Material used for blast cleaning, such as sand, grit or shot.
- 2) Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
- 3) Anchor Pattern: Profile or texture of prepared surface(s).
- 4) ANSI: American National Standards Institute.
- 5) Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
- 6) Coating/Paint/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
- 7) Coating System Applicator (CSA): A generic reference to the specialty subcontractor or subcontractors retained by the Contractor to install the coating systems specified in this Section.
- 8) Coating System Manufacturer (CSM): Refers to the acceptable coating system manufacturer, abbreviated as the CSM.
- 9) Coating System Manufacturer's Technical Representative(s) (CTR): Refers to the technical representative(s) of the acceptable Coating System Manufacturer and is abbreviated as CTR.
- 10) Dew point: Temperature of a given air/water vapor mixture at which condensation starts.
- 11) Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001 inch). Use this definition as opposed to existing definition.
- 12) Drying Time: Time interval between application and curing of material.
- 13) Dry to Recoat: Time interval between application of material and ability to receive next coat.
- 14) Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
- 15) Feather Edging: Reducing the thickness of the edge of paint.
- 16) Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.

- 17) Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
- 18) Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
- 19) Holiday: a discontinuity, skip, or void in coating or coating system film that exposes the substrate.
- 20) Honeycomb: Segregated condition of hardened concrete due to non-consolidation.
- 21) ICRI: International Concrete Repair Institute.
- 22) Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
- 23) Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
- 24) Laitance: A layer of weak, non-durable concrete containing cement fines that is brought to the surface through bleed water because of concrete finishing and/or over-finishing.
- 25) Mil: 0.001 inch.
- 26) NACE: National Association of Corrosion Engineers.
- 27) Overspray: Dry spray, particularly such paint that failed to strike the intended surface.
- 28) Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
- 29) Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
- 30) Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-base material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
- 31) Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
- 32) Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
- 33) Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
- 34) SSPC: The Society for Protective Coatings.
- 35) Stripe Coat: A separate coat of paint applied to all weld seams, pits, nuts/bolts/washers, and edges by brush. This coat shall not be applied until any previous coat(s) have cured and once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
- 36) Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
- 37) Tie Coat: An intermediate coat used to bond different types of paint coats. Coatings used to improve the adhesion of a succeeding coat.

- 38) Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
- 39) TPC: Technical Practice Committee.
- 40) Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb./gal).
- 41) Weld Splatter: Beads of metal scattered near seam during welding.
- 42) Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001 inch) and is abbreviated WFT.
- 43) Construction Manager (CM): Brunswick-Glynn Joint Water & Sewer Commission inspector or designated representative.
- 44) Owner: Brunswick-Glynn Joint Water & Sewer Commission.

1.2 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ANSI/ASC 29.4 Exhaust Systems	Abrasive Blasting Operations – Ventilation and Safe Practice
ANSI/NSF 61	Drinking Water System Components Health Effects
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Material
ASTM D16	Standard Terminology for Paint, Related Coatings, Materials, and Applications
ASTM D2200 (SSPC-VIS1)	Pictorial Surface Preparation Standards for Painting Steel Surfaces
ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4262	Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
ASTM D4263	Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness by Notch Gages
ASTM D4417	Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

Reference	Title
ASTM D4541	Standard Test Methods for Pull-Off Strength of Coatings On Metal Substrates Using Portable Adhesion Testers
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
ASTM D5162	Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
ASTM D7234	Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers.
ASTM E337	Standard Test Method for Measuring Humidity With a Psychrometer
ASTM F1869	Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
FS 595b	Federal Standard Colors
ICRI 03732	Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
NACE Publication 6D-163	A Manual for Painter Safety
NACE Publication 6F-163	Surface Preparation of Steel or Concrete Tank/Interiors
NACE Publication 6G-164 A	Surface Preparation Abrasives for Industrial Maintenance Painting
NACE Standards	January 1988 Edition of the National Association of Corrosion Engineers, TPC.
NACE Standard RP0188	Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
NACE Standard RP0288	Standard Recommended Practice, Inspection of Linings on Steel and Concrete
NACE Standard RP0892	Standard Recommended Practice, Linings Over Concrete in Immersion Service
NACE Publication TPC2	Coatings and Linings for Immersion Service
NAPF 500-03	Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
NAPF 500-03-04	Abrasive Blast Cleaning for Ductile Iron Pipe
NAPF 500-03-05	Abrasive Blast Cleaning for Cast Ductile Iron Fittings
OSHA 1910.144	Safety Color Code for Marking Physical Hazards
OSHA 1915.35	Standards – 29CFR - Painting
SSPC	Paint Application Specification No. 1.
SSPC-AB 1	Mineral and Slag Abrasives
SSPC-PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC-PA 2	Measurement of Dry Coating Thickness with Magnetic Gages
SSPC-PA 9	Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
SSPC-PA Guide 1	Guide for Illumination of Industrial Painting Project
SSPC-PA Guide 3	A Guide to Safety in Paint Application
SSPC-PA Guide 6	Guide for Containing Debris Generated During Paint Removal Operations
SSPC-PA Guide 11	Guide for Coating Concrete
SSPC SP1	Solvent Cleaning
SSPC SP2	Hand Tool Cleaning
SSPC SP3	Power Tool Cleaning
SSPC SP5	White Metal Blast Cleaning
SSPC SP6	Commercial Blast Cleaning
SSPC SP7	Brush-Off Blast Cleaning
SSPC SP10	Near-White Blast Cleaning
SSPC SP11	Power Tool Cleaning to Bare Metal
SSPC SP12	Surface Preparation and Cleaning of Steel and Other Hard Materials by High and Ultra-High Pressure Water Jetting Prior to Recoating

Reference	Title
SSPC SP13	Surface Preparation of Concrete
SSPC-TR2	Wet Abrasive Blast Cleaning
SSPC-TU-3	Overcoating
SSPC-TU-4	Field Methods for Retrieval and Analysis of Soluble Salts on Substrates.
SSPC V2	Systems and Specifications: Steel Structures Painting Manual, Volume 2
SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
SSPC-VIS 4	Visual Standards (Waterjetting)
SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
WPCF Manual of Practice No. 17	Paints and Protective Coatings for Wastewater Treatment Facilities. Guide and Paint Application Specifications.

B. Standardization:

1. Materials and supplies provided shall be the standard products of CSMs. Materials in each coating system shall be the products of a single CSM.
2. The standard products of CSMs other than those specified may be acceptable when it is demonstrated to the Construction Manager that they are equal in composition, durability, usefulness, and convenience for the purpose intended. Requests for consideration of CSMs other than those specified in this Section will be considered, provided the following minimum conditions are met. Such requests are not a substitution for submittals after the alternative CSMs have been considered and accepted.
 - a. The proposed coating system shall use an equal or greater number of separate coats to achieve the required total dry film thickness.
 - b. The proposed coating system shall use coatings of the same generic type as that specified including curing agent type.
 - c. Requests for consideration of products from CSMs other than those specified in this Section shall include information listed in paragraph 1.04 Submittals, demonstrating that the proposed CSM's product is equal to the specified coating system.
 - d. The Contractor and the proposed alternative CSM shall provide a list of references for the proposed product where the coating of the same generic type has been applied. The reference list shall include the project name, city, state, owner, phone number of owner; coating system reference and number from this Section 09 90 00; type of facility in which it was used, generic type, and year coating was applied.

C. Quality Control Requirements:

1. The Contractor is responsible for the workmanship and quality of the coating system installation. Inspections by the Construction Manager or the CTR will not relieve or limit the Contractor's responsibilities.
2. The Contractor's methods shall conform to requirements of this specification and the standards referenced in this Section. Changes in the coating system installation requirements will be allowed only with the written acceptance of the Construction Manager before work commences.

3. Only personnel who are trained by the CTR specifically for this contract or who are approved by the CSM specifically for this contract shall be allowed to perform the coating system installation specified in this Section.
4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
5. For repairs, the Contractor shall provide the same products, or products recommended by the CSM, as used for the original coating.
6. The Contractor shall identify the points of access for inspection by the Owner or the Construction Manager. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Construction Manager's personnel to access safely the work areas.
7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the specifications or is otherwise not acceptable shall be corrected as specified.
8. The Contractor shall complete the Coating System Inspection Checklist, Form 09 90 00-A, included in Section 01 99 90, for coating system installations. Follow the sequential steps required for proper coating system installation as specified and as listed in the Coating System Inspection Checklist. For each portion of the work, install the coating system and complete sign-offs as specified prior to proceeding with the next step. After completing each step as indicated on the Coating System Inspection Checklist, the Contractor shall sign the checklist indicating that the work has been installed and inspected as specified.
9. The Contractor shall provide written daily reports that present, in summary form, test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system installation.

D. Inspection at Hold Points:

1. The Contractor shall conduct inspections at designated Hold Points during the coating system installation and record the results from those inspections on Form 09 90 00-A. The Contractor shall coordinate such Hold Points with the Construction Manager such that the Construction Manager may observe Contractor's inspections on a scheduled basis. The Contractor shall provide the Construction Manager adequate notice prior to conducting Hold Point Inspections. The Hold Points shall be as follows:
 - a. Environment and Site Conditions. Prior to commencing an activity associated with coating system installation, the Contractor shall measure, record, and confirm acceptability of ambient air temperature and humidity as well as other conditions such as proper protective measures for surfaces not to be coated and safety requirements for personnel. The acceptability of the weather and/or environmental conditions within the structure shall be determined by the requirements specified by the CSM of the coating system being used.
 - b. Conditions Prior to Surface Preparation. Prior to commencing surface preparation, the Contractor shall observe, record, and confirm that oil, grease, and/or soluble salts have been eliminated from the surface.
 - c. Monitoring of Surface Preparation. Spot checking of degree of cleanliness, surface profile, and surface pH testing, where applicable. In addition, the compressed air used for surface preparation or blow down cleaning shall be checked to confirm it is free from oil and moisture.

- d. Post Surface Preparation – Upon completion of the surface preparation, the Contractor shall measure and inspect for proper degree of cleanliness and surface profile as specified in this Section and in the CSM's written instructions.
- e. Monitoring of Coatings Application – The Contractor shall inspect, measure, and record the wet film thickness and general film quality (visual inspection) for lack of runs, sags, pinholes, holidays, etc. as the application work proceeds.
- f. Post Application Inspection – The Contractor shall identify defects in application work including pinholes, holidays, excessive runs, or sags, inadequate or excessive film thickness and other problems as may be observed.
- g. Post Cure Evaluation – The Contractor shall measure and inspect the overall dry film thickness. The Contractor shall conduct a DFT survey, as well as perform adhesion testing, holiday detection, or cure testing as required based on the type of project and the specific requirements in this Section and/or in the CSM's written instructions.
- h. Follow-up to Corrective Actions and Final Inspection. The Contractor shall measure and reinspect corrective coating work performed to repair defects identified at prior Hold Points. This activity also includes final visual inspection along with follow-up tests such as holiday detection, adhesion tests, and DFT surveys.

1.3 DELIVERY AND STORAGE

A. General:

- 1. Materials shall be delivered to the job site in their original, unopened containers. Each container shall be properly labeled. Materials shall be handled and stored to prevent damage to or loss of label.
- 2. Labels on material containers shall show the following information:
 - a. Name or title of product.
 - b. CSM's batch number.
 - c. CSM's name.
 - d. Generic type of material.
 - e. Application and mixing instructions.
 - f. Hazardous material identification label.
 - g. Shelf-life expiration date.
- 3. Materials shall be stored in enclosed structures and shall be protected from weather and excessive heat or cold in accordance with the CSM's recommendations. Flammable materials shall be stored in accordance with state and local requirements.
- 4. Containers shall be clearly marked indicating personnel safety hazards associated with the use of or exposure to the materials.
- 5. Safety Data Sheets (SDS) for each material shall be provided to the Construction Manager.
- 6. The Contractor shall store and dispose of hazardous waste according to federal, state and local requirements. This requirement specifically addresses waste solvents and coatings.

1.4 SUBMITTALS

A. General:

1. Provide in accordance with Section 01 33 00 Submittal Procedures:
 - a. A copy of this specification section, with addendum updates included, and referenced and applicable sections, with addendum updates included, with each paragraph check-marked (✓) to indicate specification compliance or marked to indicate requested deviations from specification requirements or those parts which are to be provided by the Contractor or others. Check marks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for requested deviations to the specification requirements shall be cause for rejection of the entire submittal and no further submittal material will be reviewed.
 - b. CSM's current printed recommendations and product data sheets for coating systems including:
 - 1) Volatile organic compound (VOC) data.
 - 2) Surface preparation recommendations.
 - 3) Primer type, where required.
 - 4) Maximum dry and wet-mil thickness per coat.
 - 5) Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - 6) Curing time before submergence in liquid.
 - 7) Thinner to be used with each coating.
 - 8) Ventilation requirements.
 - 9) Minimum atmospheric conditions during which the paint shall be applied.
 - 10) Allowable application methods.
 - 11) Maximum allowable moisture content.
 - 12) Maximum shelf life.
 - c. Affidavits signed and sealed by an officer of the CSM's corporation, attesting to full compliance of each coating system component with current and promulgated federal, state, and local air pollution control regulations and requirements.
 - d. Safety Data Sheets (SDS) for materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
 - e. List of cleaning and thinner solutions allowed by the CSMs.
 - f. Storage requirements including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.

- g. CSM's detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, gate frames, and other terminations to be determined from the contract drawings. This information shall also include detail treatment for coating system at joints in concrete.
- h. The Contractor and CSA shall provide a minimum of five project references each including contact name, address, and telephone number where similar coating work has been performed by their companies in the past five years.

1.5 RESPONSIBILITIES OF THE CTR

A. General:

- 1. The Contractor shall retain or obtain the services of the CTR to provide and assure that the Contractor and those personnel responsible for the surface preparation and coating application are familiar the manufacturer's instructions. The level of this involvement will be determined solely between the Painting Contractor and Coating Manufacturer. The Coating Manufacturer Technical Representative (CTR) will provide the Owner documentation that the Contractor is knowledgeable and properly trained for the successful application of the products addressed in this specification.

B. Coating System Installation Training: *(The following will ONLY be required if the Coating Manufacturer cannot produce documentation that the Contractor's personnel are experienced with the products to be applied.)*

- 1. Provide a minimum of 8 hours of classroom and off-site training for application and supervisory personnel (both the Contractor's and CSA's). Provide training to a minimum of two supervisory personnel from the CSA and one supervisor from the Contractor. Alternatively, the CTR shall provide a written letter from the CSM stating that the application personnel (listed by name) who shall perform coating work are approved by the CSM without further or additional training.
- 2. One CTR can provide training for up to fourteen application personnel and three supervisory personnel at one time. The training shall include the following as a minimum:
 - a. A detailed explanation of mixing, application, curing, and termination details.
 - b. Hands-on demonstration of how to mix and apply the coating systems.
 - c. A detailed explanation of the ambient condition requirements (temperature and humidity) and surface preparation requirements for application of the coating system as well as a detailed explanation of re-coat times, cure times, and related ambient condition requirements.
 - d. When training is performed, the CTR shall provide a written letter stating that training was satisfactorily completed by the personnel listed by name in the letter.

C. Coating System Inspection:

- a. The CTR will coordinate with the Coating Contractor the necessary inspections to ensure the Owner that the Manufacturer's instructions are being followed.

D. Final Report:

- 1. Upon completion of coating work for the project, the CTR shall prepare a final report. That report shall summarize daily test data, observations, drawings, and photographs in a report to be submitted in accordance with this Section. Include substrate

conditions, ambient conditions, and application procedures, observed during the CTR's site visits. Include a statement that the completed work was performed in accordance with the requirements of this Section and the CSM's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:

- The following list specifies the material requirements for coating systems. Coating systems are categorized by generic name followed by an identifying abbreviation. If an abbreviation has a suffix number, it is for identifying subgroups within the coating system. Coating Systems E-5 shall be NSF 600 certified.

Material Requirements for Coating Systems

Coating System	CSM	First Coat(s)		Finish Coat(s)
Epoxy Coatings				
E-1	Tnemec	Series V69		Series V69
	Sherwin Williams	Macropoxy 646		Macropoxy 646
E-5	Tnemec	Series 91-94/Stripe N140		Series 21
	Sherwin Williams	Sherplate 600		Sherplate 600
E6	Tnemec	Series V69		Series V69
	Sherwin Williams	Macropoxy 646/Stripe		Macropoxy 646
EU-1	Epoxy Polyurethane	Primer Coat(s)	Intermediate Coat(s)	Finish Coat(s)
EU-1 Coating System	Sherwin-Williams	Corothane Galvpak 1k Zinc	Macropoxy 646	Hi Solids Polyurethane,
	Tnemec	Series 91-94	Series 1095	Series 700
EF-2	Tnemec	Series 238	Series 238	Series 280
	Sherwin Williams	Resuprime 3579	Resuflor M46	Resuflor 3741

2.2 PRODUCT DATA

A. General:

1. Submit reports specified in paragraph 1.02 Quality Control Requirements and 1.05 Coating System Inspection when the work is underway.
2. Submit the Coating System Inspection Checklists, using Form 09 90 00-A, included in Section 01 99 90 Reference Forms, for the coating work.
3. CTR final report in accordance with paragraph 1.05 Final Report.

PART 3 EXECUTION

3.1 COATINGS

A. General:

1. Coating products shall not be used until the Construction Manager has accepted the affidavits specified in paragraphs 1.04, the Construction Manager has inspected the materials, and the CTR has trained the Contractor and CSA in the surface preparation, mixing and application of each coating system.
2. Erect and maintain protective enclosures as stipulated per SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations.

B. Shop and Field Coats:

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended by the CSM. Data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01 Adhesion Confirmation. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this Section shall be removed and the surfaces recoated. If the shop primer coat meets the requirements of this Section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that (1) the shop applied prime coat adheres to the substrate, and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. Application Location Requirements:

1. Equipment, Nonimmersed: Items of equipment, or parts of equipment that are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the hop primer requires

topcoating within a specified period, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.

2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment that are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.
3. Steel Water Tanks: The interior surfaces of steel water tanks or reservoirs may have surface preparation and priming work performed in a shop.

3.2 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating specification sheet.
2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old-weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free from contaminants that might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture so as not to cause detrimental contamination of the surfaces to be coated.
3. Where deemed necessary by the Owner's representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before application of a coating. Surface defects identified by the inspector shall be corrected by the Contractor at no additional cost to the Owner.
4. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to the walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

B. Blast Cleaning:

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
 - a. Used or spent blast abrasive shall not be reused on this project.
 - b. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.
 - c. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by water blasting, reblasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.

- d. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. Solvent Cleaning:

1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning and shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Metallic Surfaces:

1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Society for Protective Coatings (SSPC) specified for each coating system. The profile depth of the surface to be coated shall be in accordance with Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the CSM.
2. Preparation of metallic surfaces shall be based upon comparison with SSPC-VIS1-89 (ASTM D2200). If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Construction Manager and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
3. Blast cleaning requirements for steel, ductile iron and stainless-steel substrates are as follows:
 - a. Steel piping shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) and primed before installation. Ductile iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 500-03-05.
 - b. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
 - c. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
 - d. Ambient environmental conditions in the enclosure must be constantly monitored and maintained to ensure the degree of cleanliness is held and no "rust back" occurs prior to coating material application.
4. Cleaning of soluble salt contamination shall be as follows (If detected):
 - a. Cleaning for decontamination shall utilize a steam generator capable of producing steam/hot water temperature of 150-degree F minimum to 200-degree F maximum. Hot water pressure washing at 150-degree F can also be utilized using clean, fresh, potable water only. The steam/hot water shall be applied using a lance with a nozzle providing a fan shaped spray pattern. The recommended discharge temperature is 150-degree F for safety reasons.

- b. Steam/hot water shall be applied in a minimum of two passes over all surfaces cleaned. Horizontal members on substrates shall be cleaned from end to end continuously and from top to bottom as this horizontal progression continues. Vertical pipes or substrate shall be cleaned around the circumference from top to bottom (crown to invert) to ensure complete solubility and rinsing of contaminants from top to bottom. As cleaning proceeds, the surfaces of the steel shall be scrubbed using stiff bristle brushes.

E. Concrete Surfaces: (*Composite Design – Interior dry floor*)

1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13 (also called NACE 6).
2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per CSM recommendations. This shall precede surface preparation for degree of cleanliness and profile.
3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 03732 (surface profile replicas). Surface profile requirements shall be in accordance with the Coat Spec requirements and the CSM's recommendations.
4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness prior to application of the coating system.
5. Surface preparation of concrete substrates shall be accomplished using methods such as dry abrasive blast cleaning, high, or ultra-high-pressure water blast cleaning in accordance with SSPC-SP-13. The selected cleaning method shall produce the requirements set forth below.
 - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or bugholes to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete substrate must be dry prior to the application of filler/surface or coating system materials.
 - b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
 - c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt and spent abrasive (if dry blast cleaning is used) leaving a dust free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste,

and otherwise, deleterious substances. Concrete substrates must be dry prior to the application of filler/surfacers or coating system materials.

7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be reinspected for surface cleanliness and required surface profile prior to application of the coating system.
8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method and ASTM F 1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. For concrete surfaces to be coated which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed and waterproofed in accordance with Section 07 10 00 Dampproofing and Waterproofing, perform calcium chloride tests in accordance with ASTM F-1869 once for each 500 sq. ft. of surface area to be coated. Comply with CSM's written recommendations regarding acceptance/non-acceptance of moisture vapor emissions.

3.3 APPLICATION

A. Workmanship:

1. Coated surfaces shall be free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices.
2. Each coat of coating material shall be applied evenly and sharply cut to line. Care shall be exercised to avoid overspraying or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
3. Coating applications method shall be conventional or airless spray, brush or roller, or trowel as recommended by CSM.
4. Allow each coat to cure or dry thoroughly, according to CSM's printed instructions, prior to recoating.
5. Vary color for each successive coat for coating systems when possible.
6. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties, Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Coating materials shall be thoroughly mixed, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the CSM's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the CSM immediately prior to use. The volatile organic content (VOC) of the coating as applied shall comply with prevailing air

pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the CSM.

C. Atmospheric Conditions:

1. Atmospheric Conditions: (Metal and Concrete Substrates)
2. 1. Coatings and Linings shall be applied in strict conformance with the CSM's written Application Instructions/Recommendations/Drawings for each specific substrate location and environment on the tank at the time of their application. This may require some level of containment structure, dehumidification and or heating to achieve the required conditions.

D. Should any defects be detected in the applied application; they shall be repaired as recommended by the CSM. Protection of Coated Surfaces:

1. Items that have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

E. Method of Coating Application:

1. Where two or more coats are required, alternate coats shall contain sufficient compatible color additive to act as indicator of coverage, or the alternate coats shall be of contrasting colors. Color additives shall not contain lead, or lead compounds, which may be destroyed or affected by hydrogen sulfide or other corrosive gas, and/or chromium.
2. Mechanical equipment, on which the equipment manufacturer's coating is acceptable, shall be touch-up primed and coated with two coats of the specified coating system to match the color scheduled. Electrical and instrumentation equipment specified in Divisions 26 and 40 shall be coated as specified in paragraph 3.03 Electrical and Instrumentation Equipment and Materials.
3. Coatings shall not be applied to a surface until it has been prepared as specified. The primer or first coat shall be applied by brush to ferrous surfaces that are not blast-cleaned. Coats for blast-cleaned ferrous surfaces and subsequent coats for nonblast-cleaned ferrous surfaces may be either brush or spray applied. After the prime coat is dry, pinholes and holidays shall be marked, repaired in accordance with CSM's recommendations and retested before succeeding coats are applied. Unless otherwise specified, coats for concrete and masonry shall be brushed, rolled, or troweled.
4. All exterior coatings are to be applied by roller & or brush ONLY; *NO SPRAY APPLICATION METHODS ARE PERMITTED.*

F. Film Thickness and Continuity:

1. The first coat, referred to as the prime coat, on metal surfaces refers to the first full paint coat and not to solvent wash, grease emulsifiers or other pretreatment applications. Coatings shall be applied to the thickness specified, and in accordance with these specifications. Unless otherwise specified, the average total thickness (dry) of a completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat. The minimum thickness at any point shall not deviate more than 25 percent from the required average. Unless otherwise specified, no less than two coats shall be applied.

2. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may need to be applied to achieve the specified dry film thickness.
3. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler/surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open-air voids and bugholes in the concrete substrate are completely filled prior to coating application.

G. Soluble Salt Contamination of Metallic Substrates: *(Shop coated surfaces upon delivery)*

1. Contractor shall test in accordance with SSPC-TU-4 metallic substrates to be coated that have been exposed to seawater or coastal air or to industrial fallout of particulate or other sources of soluble chlorides. If testing indicates detrimental levels of soluble salts, those in excess of 25 ppm, the Contractor shall clean and prepare these surfaces to remove the soluble salts.

3.4 CLEANUP

A. General:

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean surfaces and repair overspray or other coating-related damage.

3.5 COATING SYSTEM SPECIFICATION SHEETS (COATSPEC)

A. General:

1. Coating systems for different types of surfaces and general service conditions for which these systems are normally applied are specified on the following COATSPEC sheets. Surfaces shall be coated in accordance with the COATSPEC to the system thickness specified. Coating systems shall be as specified in this paragraph. In case of conflict between the schedule and the COATSPECS, the requirements of the schedule shall prevail.
2. Coating Specification Sheets are included this paragraph.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
E-1	Epoxy	Metal – 1. Composite Tank; Above ground piping inside concrete pedestal.	Interior; exterior, covered, not exposed to direct sunlight, non-corrosive exposure.
E-5 (NSF certified) 61	Epoxy	Metal – Steel bowl interior with potable water contact for the Composite or Spheroid Tank.	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.

Table A Coating Specification Sheets

Coating System ID	Coating Material	Surface	Service Condition
EF-2	Amine Epoxy Troweled Floor Coating	Concrete Floors for the Composite or Spheroid Tank.	Heavy-duty, wheeled traffic, frequent foot traffic, wet and moderately corrosive.
EU-1	Zinc-epoxy-polyurethane system	Ferrous Metal – All exterior steel for the Composite or Spheroid Tank.	Exterior, exposed to direct sunlight, moderately corrosive non-immersed.

3. Interior and Exterior color samples shall be provided to the OWNER for approval. Final color/s shall be based on the following Tnemec color selection:
 - A. Interior: AWWA Standard D102-21 Inside System No. 5, latest version. The minimum total dry film thickness is 12.5 mils.
 1. Tnemec: Each coat shall be a contrasting color to assure even coverage.
 - a. Prime Coat: One (1) coat Tnemec Series 91 or 94-H20, color greenish-gray applied at 2.5 to 3.5 dry mils.
 - b. Stripe Coat Welds: One (1) coat of Tnemec Series N140F-1255, color beige applied at 2.0 to 3.0 dry mils.
 - c. Finish Coat: One (1) coat Tnemec Series 21-WH16, color Off White applied at 10.0 to 12.0 dry mils.
 - d. Inaccessible Areas: Immediately after finish coat is application, all areas deemed inaccessible to coating (Skip welds, construction/design defects, etc.) shall be sealed with Sika Flex 1A or sealant approved by the coatings manufacturer.
 2. Equal zinc-rich primer and epoxy systems by Carboline, Induron, or Sherwin-Williams are acceptable if it meets and exceeds the ASTM performance standards of the basis of design. The usual “or Engineer and Owner approved equal” clause shall apply. No request for substitution will be considered that decreases the film thickness and/or the number of coats to be applied, or which offers a change from the generic type of coating specified.
 - B. Exterior: AWWA Standard D102-21 Outside System No. 6, latest version. The minimum total dry film thickness is 6.5 mils.
 1. Tnemec: Each coat shall be a contrasting color to assure even coverage.
 - a. Leg Base(s)/Top of Pier: All areas deemed deteriorating (crack, construction/design defects, etc.) above grade shall be exposed 12-inch below the ground, sealed with a sealant approved by the coating manufacturer, and the soils restored to the original grade.
 - b. Prime Coat: One (1) coat of Tnemec Series 91 or 94-H20 color greenish-gray applied at 2.5 to 3.5 dry mils.
 - c. 1st Intermediate Coat: One (1) coat Tnemec Series N69F-57BR color cloud applied at 2.0 to 3.0 dry mils applied in a color

- noticeably different than the finish coat.
- d. 2nd Intermediate Coat: One (1) coat Tnemec Series 1094-31GR, color slate gray applied at 2.0 to 3.0 dry mils.
 - e. Finish Coat: One (1) coat Tnemec Series 1094-15BL, color tank white applied at 2.0 to 3.0 dry mils.
 - f. Finish Coat (Alternate): One (1) coat Tnemec Series 700-15BL, color tank white applied at 2.0 to 3.0 dry mils. *15-year Color and Gloss Manufacturer's Warranty Required*
 - g. Lettering and Logo: Two (2) coats Tnemec 700 applied at a rate to achieve 2.0 to 3.0 dry mils per coat. Colors, Lettering, and Logos as selected by Owner and shall be painted in two (2) location on the tank. Logo/lettering to be determined by owner at time of construction.
 - h. Inaccessible Areas: Immediately after finish coat is application, all areas deemed inaccessible to coating (Skip welds, construction/design defects, etc.) shall be sealed with Sika Flex 1A or sealant approved by the coatings manufacturer.
2. Equal zinc-rich primer, epoxy, polyurethane, and fluoropolymer systems by carboline, Induron, Sherwin-Williams are acceptable if it meets and exceeds the ASTM performance standards of the basis of design. The usual "or Engineer and Owner approved equal" clause shall apply. No request for substitution will be considered that decreases the film thickness and/or the number of coats to be applied, or which offers a change from the generic type of coating specified.

Coating System Specification Sheets (COATSPEC)

A. Coating System Identification: E-1

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Interior, exterior, covered, not exposed to direct sunlight, non-corrosive exposure.

4. Surface Preparation:

- a. General: **Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive and vacuum cleaning blasting prior to receiving finish coats.**
- b. Ferrous Metal: Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) to achieve a uniform, surface profile of 2.0 to 2.5 mils.

Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-1 (Solvent Cleaning). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) (to achieve the 2.0- to 2.5-mil surface profile) and spot primed with the specified primer. For ductile iron surfaces, refer to the requirements in paragraph 3.02 Metallic Surfaces.
- c. Nonferrous and Galvanized Metal: Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve uniform, minimum surface profile 1.0 to 1.5 mils.

5. Application

- a. General: Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
- b. Ferrous Metal: Prime coats shall be an epoxy primer compatible with the specified finish coats and applied in accordance with the written instructions of the CSM.
- c. Nonferrous and Galvanized Metal: Nonferrous and galvanized metal shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).

6. System Thickness:

10 mils dry film

7. Coatings:

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

a. Primer:	One coat at CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to achieve the specified system thickness.

B. Coating System Identification: E-5 (NSF 61 certified)

1. Coating Material:	Epoxy
2. Surface:	Metal
3. Service Condition:	Interior potable water tanks and reservoirs and other metal components in contact with water being treated and stored for potable use.
4. Surface Preparation:	
a. Ferrous Metal:	<p>Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.</p> <p>Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Cleaning shall produce a surface profile of 2.0 to 2.5 mils. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.</p>

Coating System Specification Sheets (COATSPEC)

b. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to achieve a 1.0- to 1.5-mil profile that is uniform.
5. Application:	Field
a. General:	Prime coat shall be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coat shall be an epoxy primer compatible with the specified finish coats.
c. Nonferrous and Galvanized Metal:	Nonferrous and galvanized metal above the high-water elevation shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
6. System Thickness:	10 mils dry film.
7. Coatings:	
a. Primer:	One coat at the CSM's recommended dry film thickness.
b. Finish:	One or more coats at CSM's recommended dry film thickness per coat to the specified system thickness.

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

C.

1.	
2.	
3.	
4.	
a.	
b.	
5.	
a.	
6.	
7.	
a.	
b.	

D. Coating System Identification: EF-2

1. Coating Material:	Epoxy Resin Based Floor Coating
2. Surface:	Concrete Floors
3. Service Condition:	For interior – heavy-duty exposure applications. Frequent, heavy wheeled traffic and moderately corrosive exposure conditions. Mainly for wear resistance, impact resistance, protection of concrete, and aesthetics. Non-slip texture can be varied as needed. Test patches to be installed for deciding on level of non-slip texture required.
4. Surface Preparation:	Concrete floor slabs shall be allowed to age for at least 28 days and must meet a moisture vapor transmission rate of less than 3.0 lbs. of moisture per 24 hours per 1,000 SF in accordance with ASTM F1869. It is also essential that a well-sealed and intact vapor barrier has been installed beneath all slabs on grade to receive this floor coating system. Except as otherwise specified, loose concrete, curing compounds, and laitance shall be removed by abrasive blast cleaning or preferably by shotblasting. Surface preparation shall produce a clean sound concrete substrate with a concrete surface profile of CSP-7 minimum in accordance with ICRI 03732. Surface preparation shall be in accordance with SSPC-SP-13.

Coating System Specification Sheets (COATSPEC)

	<p>Additionally, all coating termination and transition details shall be prepared in accordance with the CSM's standard detail drawings. This includes coating termination details, coating transitions at vertical and vertical to horizontal corners, coating terminations at joints, concrete crack treatment, pipe penetration treatment, coating terminations at metal embedments in the concrete substrate, and other details. The CSM's standard detail drawings shall be submitted for all such coating applications. If standard details are not available for a given detail treatment, the CSM shall be required to produce one at no additional cost to the owner, the engineer, or any other party.</p> <p>If wet abrasive or water blasting surface preparation methods were used, the concrete substrate shall be allowed to dry under warm conditions (minimum of 75 degrees F) for at least 5 days prior to coating application. Following surface preparation work and dry-out, all surfaces to be coated shall be vacuum cleaned to remove all loose dirt, dust, or other loose materials.</p>
5. Application:	Carefully follow CSM's written instructions regarding mixing, thinning, application, recoat limitations (windows) and curing of coating materials.
6. System Thickness:	250 mils dry film.
7. Coatings:	
a. Primer:	Brush or roller apply at 6.0 – 10.0 mils DFT.
b. Trowel Applied:	Trowel apply to 230 – 236 mils.
c. Top:	Brush or roller apply at 8.0 – 10.0 mils. Cumulative dry film thickness.
	Install all termination and transition details in accordance with the CSM's detail drawings.
E. Coating System Identification: EU-1	
1. Coating Material:	Zinc-Epoxy-Polyurethane System
2. Surface:	Ferrous Metal
3. Service Condition:	Exterior, exposed to direct sunlight, moderately corrosive, non-immersed.
4. Surface Preparation:	
a. General:	Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-3 (Power Tool Cleaning) and recoated with the primer specified.
b. Ferrous Metal:	<p>Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) 2.5 – 3.0. Ductile iron surfaces to be coated shall be abrasive blast cleaned in accordance with paragraph 3.02 Metallic Surfaces.</p> <p>Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC-SP-11 (Power Tool Cleaning to Bare Metal). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.</p>
c. Galvanized Metal:	<p>Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC-SP-11 to achieve a uniform 1.0- to 1.5-mil profile and spot primed with the primer specified.</p> <p>Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-7 (Brush-off Blast Cleaning) to impart a 1.0- to 2.0-mil profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP-3, Power Tool Cleaning to impart a 1.0- to 1.5-mil profile uniformly to the galvanized steel surfaces.</p> <p>For EU-1 over galvanized steel, delete the zinc rich primer.</p>
5. Application:	Field
a. General:	Prime coat may be thinned and applied as recommended by the CSM, provided the coating as applied complies with prevailing air pollution control regulations.
b. Ferrous Metal:	Prime coats shall be a zinc rich epoxy or polyurethane primer compatible for use with urethane finish coats and applied in accordance with written instructions of the CSM or in the case of CARB or SCAQMD applications, prime with specified primer that is not zinc rich. In these cases, only a two-coat system is applied.

Coating System Specification Sheets (COATSPEC)

6. System Thickness:	3 to 4 mils of zinc rich primer, one intermediate or primer epoxy coat at 5 to 6 mils and one finish coat of polyurethane at 2 to 3 mils DFT.
7. Coatings:	
a. Primer:	One coat at CSM's recommended dry film thickness.
b. Intermediate:	One coat at CSM's recommended dry film thickness.
c. Finish:	One coat at CSM's recommended dry film thickness per coat to meet the specified system thickness.

3.6 INSPECTION AND TESTING BY OWNER

A. General:

1. Inspection by the Owner or others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Inspection by the Owner is in addition to any inspection required to be performed by the Contractor.
2. The Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section. These inspections may include the following:
 - a. Inspect materials upon receipt to ensure that are supplied by the CSM.
 - b. Inspect to verify that specified storage conditions for the coating system materials, solvents and abrasives are provided.
 - c. Inspect and record findings for the degree of cleanliness of substrates.
 - d. Inspect and record the pH of concrete and metal substrates.
 - e. Inspect and record substrate profile (anchor pattern)
 - f. Measure and record ambient air and substrate temperature.
 - g. Measure and record relative humidity.
 - h. Check for the presence of substrate moisture in the concrete.
 - i. Inspect to verify that correct mixing of coating system materials is performed in accordance with CSM's instructions.
 - j. Inspect, confirm, and record that the "pot life" of coating system materials is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
 - k. Perform adhesion testing.
 - l. Measure and record the thickness of the coating system.
 - m. Inspect to verify proper curing of the coating system in accordance with the CSM's instructions.
 - n. Perform holiday or continuity testing for coatings that will be immersed or coatings that will be exposed to aggressively corrosive conditions.

3.7 FINAL INSPECTION

A. General

1. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the specifications.
2. The Construction Manager will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

3. Any rework required shall be marked. Such areas shall be recleaned and repaired as specified at no additional cost to the Owner.

END OF SECTION

DIVISION 26

ELECTRCIAL

26 01 00	Basin Electrical Requirements
26 05 00	Common Work Result for Electrical
26 09 13	Electrical Power Management Systems

SECTION 26 01 00
ELECTRICAL

26 01 00 - BASIC ELECTRICAL REQUIREMENTS

1.01 QUALITY ASSURANCE

- A. All electrical work shall be in accordance with the following codes and agencies:
 - 1. The National Electrical Code (NFPA-70), 2020 Edition.
 - 2. The International Building Code, 2018 Edition with 2020 Georgia Amendments.
 - 3. Regulations of the local utility company concerning metering and service entrance.
 - 4. State and local ordinances governing electrical work.
- B. All materials shall be new and shall conform to standards where such have been established for the particular material. All UL listed equipment shall bear the UL label.

1.02 PERMITS

- A. Obtain all permits and inspections required for the work involved. Deliver to the owner all certificates of inspection.

1.03 WARRANTY

- A. The contractor shall warrant to the owner that all work shall be free from defects and will conform to the contract documents. This warranty shall extend not less than one year from the date of beneficial occupancy. Provide longer warranties where specified.

1.04 DRAWINGS

- A. The drawings indicate the general arrangement of electrical equipment, based on one manufacturer's product. Coordinate installation of equipment with all other trades. Do not scale drawings for connection locations. Bring all discrepancies to the immediate attention of the Engineer.
- B. Contractor shall install and circuit all electrical work as indicated on drawings unless specific building construction requires a change or rerouting of this work. He shall keep a record of the location of all concealed work, including the underground utility lines. He shall document all changes in the manner specified by the General Conditions, Special Conditions and Supplementary General Conditions to the Mechanical and Electrical Work.

1.05 EQUIPMENT REQUIRING ELECTRICAL SERVICE

- A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all such equipment.
- B. Drawings are based on design loads of one manufacturer. If equipment actually furnished have loads, numbers of connections, or voltages other than those indicated on the drawings, then control equipment, feeders, and overcurrent devices shall be adjusted as required, at no additional cost to the owner. Such adjustments are subject to review by the Engineer.
- C. Catalog numbers indicated with equipment, devices and lighting fixtures are for convenience only. Errors or obsolescence shall not relieve the furnishing of items which meet the technical description given in specifications, noted, or required by function designated.

1.06 SITE INVESTIGATION

- A. Prior to submitting bids for the project, visit the site to become familiar with existing conditions. The project shall be restored to its existing condition, with the exception of work under this contract, prior to final payment.

1.07 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Provide a dry, weather tight space for storing materials. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact. Handle and store material in accordance with standards to prevent damage. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable. Replace damaged materials.

1.08 CLEANING AND PAINTING

- A. Remove oil, dirt, grease and foreign materials from all equipment to provide a clean surface. Touch up scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, and equipment enclosures with paint manufactured specifically for that purpose.

1.09 RECORD DRAWINGS

- A. At the time of final inspection, provide three (3) sets of data on electrical equipment used in the project. This data shall be in bound form and shall include the following items:
 - 1. Shop drawings on equipment listed.
 - 2. Data sheets indicating electrical characteristics of all devices.
 - 3. Data sheets on all lighting fixtures indicating voltage, illumination source used in each fixture.
 - 4. Test results required by "Electrical Systems Operation Test."

1.10 ELECTRICAL SYSTEMS OPERATIONAL TEST

- A. Prior to final inspection, the following systems or equipment shall be tested and reported as herein specified.
 - 1. Each ground rod installation shall be tested after all connection to ground rods are made. Ground rod installations shall be tested by "fall of potential" measuring method using ground resistance test meter and two auxiliary electrodes driven into the earth, interconnected through the meter with the ground rod installation being tested. Placement of auxiliary electrodes shall be in accordance with operating instructions of test meter, but in no case shall auxiliary current electrodes be placed within seventy feet of the grounding system being tested. Test data shall indicate placement of auxiliary electrodes with respect to system being tested, data readings were taken and lowest resistance recorded.
 - 2. Provide startup for tank lighting system and obstruction lighting. Submit documentation, including warranty with Record Drawings.
 - 3. Three (3) typewritten copies of the test shall be submitted to the Engineer for approval.

1.11 MATERIALS

- A. Materials or equipment specified by manufacturer's name shall be used unless approval of other manufacturer is listed in addendum to these specifications. Request for approval of substitute materials shall be submitted in writing to the Engineer at least ten (10) days prior to bid opening.
 - 1. Where substitution of materials alters space requirements indicated on the drawings, submit shop drawings indicating proposed layout of space, all equipment to be installed therein, and clearances between equipment. All clearances required by the National Electrical Code must be maintained.
 - 2. All material shall be new and shall conform to the applicable standard or standards where such have been established for the particular material in question. Publications and Standards of the organizations listed below are applicable to materials specified herein.
 - a. American Society for Testing and Materials (ASTM)
 - b. Underwriter's Lab (UL)
 - c. National Electrical Manufacturer Association (NEMA)
 - d. Insulated Power Cable Engineers Association (IPCEA)
 - e. Institute of Electrical and Electronic Engineers (IEEE)
 - f. Edison Electric Institute (EEI)
 - g. National Fire Protection Association (NFPA)
 - h. American National Standards Institute (ANSI)
 - 3. Material of the same type shall be the product of one manufacturer.
 - 4. U.L. listed material shall bear a U.L. label.

1.12 SHOP DRAWINGS

- A. The Contractor shall submit for review by the Engineer a complete schedule and data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, such as catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer, to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Complete electrical characteristics shall be provided for all equipment.
- B. Submittals shall be made for each of the following items:

Panelboards	Obstruction Lighting System
Wiring Devices	Tank lighting System Lighting
Fixtures	Surge Protection
SCADA System	Poles - Fiberglass
- C. Each individual submittal item for materials and equipment shall be marked to show specification section and paragraph number which pertains to the item.
- D. Prior to submitting shop drawings, review the submittal for compliance with the Contract Documents and place a stamp or other confirmation thereon which states that the submittal complies with Contract requirements. Submittals without such verification will be returned disapproved without review.

16100 - BASIC MATERIALS

2.01 RACEWAYS

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratory, Inc. Publications 1, 6, 467, 651, 797, 1242.
 - 2. American National Standards Institute C-80.1, C-80.3.
- B. Raceway is required for all wiring, unless specifically indicated or specified otherwise. The minimum size of conduit shall be $\frac{3}{4}$ " but shall not be less than size indicated on the drawings or required by the NEC.
- C. Conduits shall be provided for the following conditions:
 - 1. Conduits above grade shall be aluminum rigid conduit (ARC).
 - 2. Conduits installed within concrete slabs shall be schedule 80 heavy wall PVC. Where transition is made from raceway in slab to any type of raceway out of slab, make transition with an ARC
 - 3. Conduits installed in direct contact with earth shall be schedule 80, heavy wall PVC.
- D. ARC fittings shall be standard threaded couplings, threaded hubs, bushings, and elbows. All ARC fittings shall be aluminum alloy; set screw or non-threaded

fittings are not permitted. Non-metallic conduit fittings shall be of the same material as the conduit furnished and shall be the product of the same manufacturer.

- E. All conduit support parts and hardware shall be stainless steel. Conduit clamps shall be two piece 316 stainless steel type. Conduit support channels shall be 1-5/8" x 1-5/8" - 14 gauge channel. Wire or chain is not acceptable for conduit hangers. Individual conduit hangers shall be stainless steel specifically designed for the purpose.
- F. Leave all empty conduits with a 200 lb. test nylon cord pull line. Complete raceway runs prior to installation of wires or cables. Deformed conduits shall be replaced. Protect conduits against dirt, plaster, and foreign debris with conduit plugs.
- G. Fasten conduit support devices to structure with toggle bolts on hollow masonry, expansion anchors on solid masonry or concrete, and machine bolts or clamps on steel. Nails are not acceptable.
- H. Conduit shall be run parallel or at right angles to walls, ceilings, and structural members. Support branch circuit conduits at intervals not exceeding 10 feet, and within 3 feet of each box or change of direction.
- I. All conduits entering or exiting concrete or installed below grade shall be protected from corrosion.
 - 1. Metallic conduits shall be protected from corrosion as follows:
 - a. Apply two coats of 3M Scotchrap pipe primer. Allow the primer to dry before application of the second coat or application of tape.
 - b. Apply two overlapping layers of 3M Scotchrap 51 tape.
 - c. Pipe primer and tape shall extend from the end of the metallic conduit to 6" above grade or concrete.
- J. All conduits entering electrical equipment from below grade shall be sealed with electrical putty.

2.02 WIRES AND CABLES

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratories, Inc. Publications 44, 83, 486, 493.
 - 2. Insulated Cable Engineers Association Standards S-61-402, S-66-524.
 - 3. National Electrical Manufacturer's Standards WC-5, WC-7.
- B. Conductors shall be electrically continuous and free from short circuits or grounds.
- C. All open, shorted, or grounded conductors and any with damaged insulation shall be removed and replaced with new material free from defects.

- D. Conductor size shall be minimum of No. 12 AWG, unless larger size is required by the drawings or the NEC. Insulation voltage level rating shall be 600 volts. All wire and cable shall bear the UL label. Data, and communication conductors are not included in this specification; they shall comply with NEC requirements.
- E. Conductors No. 10 and smaller shall be solid copper, 90 degrees C. type THWN/THHN. Conductors larger than No. 10 shall be stranded copper, 90 degrees C. type THWN/THHN, or XHHW.
- F. Color code all conductors. No. 6 and smaller shall have solid color compound or coating. No. 4 and larger shall have solid color compound or colored phase tape; tape shall be installed on conductors in every box, termination point, cabinet, or enclosure. Coding shall be as follows:
 - 1. 240/120 volt single phase three wire system: Phase A-black, Phase B-red, neutral-white.
 - 2. Grounding conductors shall be green or green traced.
- G. Maintain phase rotation established per N.E.C. at service equipment throughout entire project.
- H. Group and lace with nylon tie straps all conductors within enclosures. Make splices in conductors only within junction boxes, wiring troughs, or other NEC approved enclosures. Do not splice conductors in pull boxes, switchboards, panelboards, safety switches, or motor control enclosures. Identify each conductor as to circuit connection in all boxes and enclosures.
- I. Terminate stranded conductors No. 10 AWG and smaller with crimp-type lug or stud. Crimp terminal shall be the configuration type suitable for terminal point.
- J. Torque each terminal connection to the manufacturer's recommended torque value. A calibrated torquing tool shall be used to insure proper torque application.

2.03 BOXES

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratories, Inc. Publications 50, 467, 514.
- B. Boxes shall be hot-dipped galvanized steel sheet metal unless rustproof cast metal is specified or required by the NEC. Boxes for surface mounted lighting fixtures shall be 4" octagon boxes, 1 1/2" deep. Switches, receptacles, and wall mounted junction boxes shall be 4" square boxes, 1 1/2" deep. Outlet boxes for GFI receptacles shall be 2 3/4" deep.
- C. Outlet boxes for switches and receptacles in exposed wiring systems shall be cast FS type with matching device plate. For exterior installations, use extra duty in-use hinged covers. Boxes for individual devices flush mounted in exposed concrete

block shall be single gang masonry boxes 3 1/2" deep. Provide larger boxes as required for special purpose devices.

- D. Dimensions of pull and junction boxes shall not be less than those required by the NEC for the number, size, and position of conductors entering the box. Wood supports within pull boxes are not acceptable. Provide box covers for all boxes.
- E. All boxes shall be completely accessible and as required by the NEC. Provide access panels in all non-accessible spaces to permit access to boxes. Provide an outlet box for each lighting fixture or as indicated on the drawings and for each device. Box sizes shall be increased from those outlined above if required by Article 314 of the NEC.
- F. Support every box from structure.
- G. Remove only knockouts as required and plug all unused openings. After completion, using indelible ink wide tip marker, indicate on the cover of each junction and pull box the designation of each circuit contained therein.

2.04 WIRING DEVICES

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. National Electrical Manufacturer's Association Publications WD-1, WD-5.
- B. Single pole, 20 amp, 277 volt toggle switches shall be Hubbell 1221. Weatherproof, 20 amp, 277 volt switches shall be Hubbell 1281-1750. Equivalent switches manufactured by Arrow Hart, Legrand, or Leviton are acceptable.
- C. Fifteen amp, 125 volt grounded duplex receptacles (NEMA 5-15R) shall be Hubbell 5252. Twenty amp, 125 volt grounded duplex receptacles (NEMA 5-20R) shall be Hubbell 5352. Ground fault interrupter (GFI) receptacles shall be Hubbell GFWRST20W. Equivalent receptacles manufactured by Arrow Hart, Legrand, or Leviton are acceptable.
- D. Device plates shall be one piece single or multi-gang type selected to match the device or combination of devices. Device plates for flush mounted devices shall be steel. All devices installed in areas exposed to the weather shall be provided with a weatherproof device plate.
- E. All devices shall be provided with ivory finish.

2.05 SUPPORTING DEVICES

- A. Provide and install supporting devices which comply with manufacturer's standard materials, design, and construction in accordance with published standards and as required for complete installation.

- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices. Install hangars, supports, clamps, and attachments to support piping properly from building structure only.

2.06 ELECTRICAL IDENTIFICATION

- A. Install engraved plastic - laminate sign on each major unit of electrical equipment. Provide a single line of text, 1/2" high lettering on 1 1/2" high sign (or 2" high sign if 2 lines required). Provide signs for each unit of the following:
 - 1. Enclosed Breakers
 - 2. Panelboards
 - 3. Electrical Cabinets and Enclosures
 - 4. Tank Lighting Controller
 - 5. Obstructions Light Controller

16400 - DISTRIBUTION EQUIPMENT

3.01 GROUNDING SYSTEMS

- A. Equipment grounding system shall be established with equipment ground conductors. The use of metallic raceways for equipment grounding is not acceptable. Unless indicated otherwise, provide equipment ground the same size as phase conductors.
- B. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratories, Inc. Publications 44, 83, 467, 486, 493.
 - 2. National Electrical Manufacturer's Association Standards WC-5, WC-7.
- C. Grounding electrode conductors shall be bare or green insulated copper sized as indicated on the drawings. Equipment grounding conductors shall be green insulated type THW, THWN, or XHHW sized as indicated on the drawings. Where sizes are not indicated, grounding conductor shall be sized in accordance with NEC Article 250.
- D. Each receptacle and switch device shall be furnished with a grounding screw connected to the metallic device frame. Provide a conductor termination grounding lug bonded to the enclosure of each enclosed breaker.
- E. Ground all non-current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction boxes, machine frames, and other conductive items in close proximity with electrical circuits. Grounding connections to structural steel shall be made with a chemical exothermic weld.
- F. Grounding conductors for branch circuits are not shown on the drawings; however, grounding conductors shall be provided in all branch circuit raceways and cables,

including flexible conduit. Grounding conductors shall be the same AWG size as branch circuit conductors.

- G. The equipment grounding conductor shall be terminated with a screw or bolt used for no other purpose. Equipment grounding conductors shall terminate on panel board, switchboard, or motor control center grounding bus only. Do not terminate on neutral bus.

3.02 ENCLOSED BREAKERS

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratories, Inc. Publications 50, 67,489.
 - 2. National Electrical Manufacturer's Association Publications PB-1, AB-3.
- B. Products of GE/ABB, Eaton or Square D which comply with these specifications are acceptable.
- C. All circuit breakers shall be UL listed and bear a UL label. Where enclosed breakers serve as service entrance equipment, breaker assembly shall bear a UL label indicating such. Enclosed shall be of the dead front safety type.
- D. Breaker lugs shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each enclosed breaker shall contain mechanical lugs for each conductor and, when required, a full size insulated neutral. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection.
- E. Provide gutters and bending space to conform with the NEC. Key all enclosures throughout the project alike.
- F. Circuit breakers shall be quick-make, quick-break, thermal magnetic type. Multi-pole breakers shall be common trip and common reset type; tie handle connections are not acceptable. Interrupting ratings on 240 volt systems shall be 10,000 RMS symmetrical amps minimum; provide higher ratings when indicated on the drawings.
- G. Mount enclosed breakers with operating handle not more than 6'-6" above finished floor. Enclosures shall be secured by a minimum of four fastening devices. Attach enclosure directly to masonry or concrete, maintaining a 1" rear clearance. Mount enclosure to metal channel for installations on steel structure or masonry.

3.03 PANELBOARDS

- A. The following specifications and standards are incorporated into and become a part of this specification:
 - 1. Underwriter's Laboratories, Inc. Publications 50, 67,489.

2. National Electrical Manufacturer's Association Publications PB-1, AB-3.

- B. Products of GE/ABB, Eaton, or Square D which comply with these specifications are acceptable.
- C. All panels and circuit breakers shall be UL listed and bear a UL label. Panels shall be of the dead front safety type. Provide panels complete with factory assembled circuit breakers connected to the bus bars. Number all panelboards in the following sequence: Circuits 1 and 2 - Phase A; circuits 3 and 4 - Phase B.
- D. All bus bars shall be copper. Main lugs and main breaker shall be UL approved for copper or aluminum conductors and shall be of a size range for the conductors indicated on the drawings. Each panel shall contain a full size grounding bus and, when required, a full size insulated neutral bus. The neutral and ground busses shall have a sufficient number of lugs to singularly terminate each individual conductor requiring a connection. The ground bus shall be brazed or riveted to the panel enclosure, but not attached to the panel interior. Where designated, each 'space' shall include all bussing, device supports and connections for future breaker installation. Where indicated, provide sub-feed or through-feed lugs and increase box height to provide additional cable bending space; lug size shall match ampacity of mains.
- E. Branch circuit panel board width shall be between 20 and 22 inches; depth shall be 5 3/4" maximum. Distribution panel board width shall be 32" minimum and depth shall be 14" maximum. Provide gutters and bending space to conform with the NEC. Key all panels throughout the project alike.
- F. Circuit breakers shall be quick-make, quick-break, thermal magnetic type bolted to the bus. Multi-pole breakers shall be common trip and common reset type; tie handle connections are not acceptable. Interrupting ratings on 240 volt systems shall be 10,000 RMS symmetrical amps minimum; provide higher ratings when indicated on the drawings. Provide the following when specified, indicated on the drawings, or required by the NEC:
1. Ground fault interrupting circuit breaker (GFI).
- G. Mount panel boards with top circuit not more than 6'-6" above finished floor. Enclosures shall be secured by a minimum of four fastening devices. Attach enclosure directly to masonry, concrete, or wood, maintaining a 1" rear clearance. Mount enclosure to metal channel for installations on steel structure.
- H. Provide in each panel board a typewritten circuit directory mounted under clear plastic in metal holder in the door of the panel reflecting all field changes additions. Install push-in knock-out closure plugs in any unused knock-out openings.

END OF SECTION

SECTION 26 05 00.01
COMMON WORK RESULT FOR ELECTRICAL

PART 1 – GENERAL

1.1 DESCRIPTION

- A. Scope: This section specifies general requirements for electrical work. Project Detailed requirements specified in other sections are subject to the general requirements of this section.
 - 1. Furnish labor, equipment, tools, materials, supplies, and perform operations necessary to install a complete and operable electrical system. Furnish incidental material and perform work shown on the Drawings and in the Specifications.
 - 2. Perform electrical work and provide material and equipment in compliance with applicable National, State, and Local codes, regulations, laws, and ordinances.
 - 3. Obtain electrical permits, arrange for required inspections, correct deficiencies resulting from inspections, and pay permit fees and inspections charges. Pay fines and the cost of extra work incurred by action or inaction of the Contractor, at no additional cost to the Owner.
 - 4. Furnish properly executed certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) at the conclusion of the work before final acceptance.
 - 5. Maintain a complete set of Contract Drawings in "Record" condition, available for review by the Owner or Engineer. Mark, initial, and date changes, modifications, or corrections, as they occur. Refer to the Record Drawing specification section requirements.
 - 6. Field verify the exact locations of equipment or equipment terminations. Use accepted equipment submittals as the basis of the conduit openings and slab penetrations.
 - 7. Contractor shall coordinate with the requirements of the elevated storage tank specifications
- B. Drawing Definitions and Requirements:
 - 1. Elementary or Schematic Diagram: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement that facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.
 - 2. One-Line Diagram: Shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
 - 3. Block Diagram: Diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
 - 4. Wiring Diagram or Connection System: Includes all the devices in a system and shows their physical relationship to each other including terminals and

interconnecting wiring in an assembly. A panel layout diagram shows the physical location of devices and the wiring connections.

5. Interconnection Diagram:
 - a. Shows external connections between terminals of equipment in panels or electrical assemblies and outside points, such as motors, auxiliary devices, control devices, and instruments. Provide references to connection diagrams that interface to the interconnection diagrams of the continuous line type.
 - b. Show bundled wires as a single line with the direction of entry/exit of the individual wires clearly shown. Show each wire identification as actually installed. Wireless diagrams and wire lists are not acceptable.
 - c. Provide wire identification for each end of the same wire for devices and equipment, indicate terminal blocks identification installed with individual terminal identification.
 - d. Show jumpers, shielding and grounding termination details not shown on the equipment connection diagrams on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Show spare wires and cables.
6. Arrangement, Layout, or Outline Drawings: Shows the physical space and mounting requirements of a piece of equipment and may indicate ventilation requirements, space provided for connections, or the location connections are to be made.
7. Drawing Cross-Referencing:
 - a. Reference each submittal drawing submitted to the associated Contract Document and indicate the one-line diagrams, schematics, control diagrams, block diagrams, and Process and Instrumentation Diagrams (P&IDs) cross-referenced on the submittal drawings.
 - b. Internally cross-reference submittal drawings related to the same subject shall be referenced to other submittal drawings. Failure to cross-reference Contract Documents with the submittal shall be cause for rejection of the entire submittal with no further consideration.

1.2 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1 / ASCE 7	Minimum Design Load in Buildings and Other Structures, 1982
ANSI C80.1	Rigid Steel Conduit - Zinc Coated, 1994
ASTM B3	Standard Specification for Soft or Annealed Copper Wire, 2001
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft, 1999
ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes, 2000
ICEA S-68-516 / NEMA WC 70, 71, & 74	Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-95-658	Standard for Non-Shielded Power Cables Rated 2000 Volts or Less, 2000
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System, 1983
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations, 1974 (1992)
JIC EMP-1	Electrical Standard for Mass Production Engineering, 1967
NEMA TC2	Electrical Polyvinyl Chloride (PVC) Conduit, 2003
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA WC-70	Non-Shielded Power Cable 2000V or Less (ICEA S-95-658), 1999 (2001)
NEMA WD-1	General Requirements for Wiring Devices, 1999
NFPA 70	National Electrical Code (NEC)
UBC	Uniform Building Code
UL 6	Electrical Rigid Metal Conduit – Steel, 12th Edition, 2000 (2003)
UL 44	Thermoset-Insulated Wires and Cables, 15th Edition, 1999 (2002)
UL 67	Panelboards, 11th Edition, 1993 (2003)
UL 83	Thermoplastic-Insulated Wires and Cables, 13th Edition, 2003 (2004)
UL 263	Fire Tests of Building Construction and Materials, 13th Edition, 2003
UL 360	Liquid-Tight Flexible Steel Conduit, 5th Edition, 2003
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, 10th Edition, 2002 (2003), Adopted: NEMA AB 1-1999
UL 1277	Electrical Power and Control Tray Cables with Optional Optical-Fiber Members, 4th Edition, 2001 (2003)

B. Listed and Labeled Products:

1. Provide electrical equipment and materials listed or labeled by an independent testing laboratory for the purpose for which they are to be used and provide associated testing laboratory label.
2. The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction. Test Laboratory examples: Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), and Canadian Standards Association (CSA).

3. Include costs and expenses incurred for special inspections in the contract price for electrical products required to undergo a special inspection either at the manufacturer's place of assembly or at the installed location by the local inspection authority when a product is not available with a testing laboratory listing or labeling.

1.3 SUBMITTALS

- A. The following information shall be provided for all electrical equipment and materials in accordance with Section 01 33 00:
 1. Catalog cuts of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information with technical specifications and application information including ratings, range, weight, accuracy, and other pertinent product information.
 - b. Edit catalog cuts to show only the items, model numbers, and information that apply.
 - c. Assemble catalog cuts in a folder or three ring binders with a cover sheet, indexed by item, and cross-referenced to the appropriate specification paragraph.
 2. Arrangement, layout, and outline drawings with dimensions and weight, as appropriate.
 3. Control schematics and interconnection wiring diagrams depicting internal and external wire and cable terminations. Drawing cross-reference to specification and Contract Document drawings.

1.4 DRAWINGS

- A. Prepare specified drawings on 11-inch by 17-inch drafting media complete with borders and title blocks clearly identifying project name, equipment, and the scope of the drawing.
- B. Prepare drawings to reflect the final constructed state of the project installation or supplied equipment. Provide drawing quality, clarity, and size of presentation to permit insertion in operation and maintenance manuals.

1.5 PROJECT/SITE CONDITIONS

- A. General:
 1. Unless otherwise specified, equipment and materials shall be sized and de-rated for the ambient conditions specified in Section 01 11 80.
- B. The following areas are designated as wet/corrosive:
 1. All areas
- C. Hazardous (Classified) Areas:
 1. None

D. Seismic:

1. Electrical equipment and supports shall be braced in accordance with all applicable building codes.

E. Construction Materials:

1. Refer to the individual specification section for each component for material composition and installation practices.
2. Construction materials required for each area classification are listed in the following table that specifies the type of raceway required for each location and application by RACESPEC sheet. Unscheduled conduit shall be galvanized rigid steel conduit: RACESPEC type RMC-Steel.

Location	Application/Condition	RACESPEC
Indoor non-corrosive	Exposed	RMC-Steel
Indoor corrosive	Exposed	RMC-Steel
Outdoor	Exposed	RMC-Steel
Hazardous	Exposed	RMC-Steel
Concealed	Embedded in concrete structure or beneath slab-on-grade	RMC-Steel, RNC40, or RNC80, as shown
Underground	Instrumentation, communications, and data signals encased in concrete, ductbank	RMC-Steel, RNC40, or RNC80, as shown
Underground	Instrumentation, communications, and data signals directly buried	RMC-Steel, RNC40, or RNC80, as shown
Underground	Power directly buried (Non-Power Utility)	RNC40
Nonhazardous	Final connection to equipment	RMC-Steel
Hazardous	Final connection to equipment	Fittings per NEC Article-500 for the Classified Hazardous Area identified.
Corrosive	Final connection to equipment	RMC-Steel, RNC40, RNC80, Coated Flexible Steel Fittings, as appropriate

Notes:

1. Install conduit connections to control stations, enclosures, and device boxes through threaded hubs.
2. Install flexible conduit for final connections to devices, equipment and motors not exceeding 18 inches. Limit length to 36 inches where flexibility is required.
3. Mount enclosures, device boxes, control stations, and raceway systems with 1/4-inch (minimum) air space between the electrical system and supporting structure.

1.6 STORAGE OF MATERIALS AND EQUIPMENT

- A. Store equipment and materials in the factory-sealed container and protect with additional covering and materials to avoid physical damage or weather damage.

1.7 ELECTRICAL NUMBERING SYSTEMS

A. Raceway Numbers:

1. Tag raceways with brass tags at the access locations including manholes, pull boxes, junction boxes, and at the terminations.
2. Raceway numbers shall be coordinated with the Owner.

B. Wire and Cable Circuit Numbers:

1. Identify wire and cable circuit numbers at both ends. Refer to the circuit labeling method specified and shown in the drawings to label circuits.
2. Identify lighting and receptacle branch circuits with the power source and circuit load, at source and destination locations. Identify the load, location, and circuit in typed panel schedules with corrections shown.
3. Include copies of schematic diagrams, wiring connection diagrams, and interconnection diagrams inside of the equipment enclosure, protected in a plastic container in the equipment print holder.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. General:

1. Provide new equipment and materials free from defects. Provide material and equipment of the same or a similar type of the same manufacturer throughout the work. Use standard production materials wherever possible.

B. Paint Finish and Galvanizing:

1. Paint installed and unpainted electrical construction materials as specified in Section 09 90 00. Galvanize products, supports, etc. as specified in the Hot-Dip Zinc Coating section.

2.2 RACEWAYS, BOXES, AND SUPPORTS

A. Raceways and Boxes:

1. Pullboxes, handholes, and device boxes are generally called boxes herein. Size boxes, manholes, and handholes in accordance with the National Electrical Code. Provide separate raceways for lighting, receptacles, power, control, instrumentation, and signaling systems.

B. Boxes and Wireways:

1. Provide indoor boxes, larger than FD boxes, constructed of stainless-steel.
2. Provide boxes constructed of Grade 316L stainless-steel rated NEMA-4X for corrosive areas and for outdoor locations.
3. Size and provide wireways at locations above and below boxes, panels, and groups of devices. Comply with the NEC sizing for conductor fill requirements. Wireway NEMA type shall match the location and area classification and equipment NEMA enclosure ratings.

C. Terminal Cabinets: Not Used

D. Manholes, Handholes and Pullboxes:

1. Manholes, handholes and pullboxes generally called boxes herein, contain wires, cables, and conductors. Provide box dimensions where shown. Provide boxes per NEC sizing rules where the dimensions are not sized or shown.
2. Provide concrete boxes with covers designed for H-20 loading in traffic areas. Engrave box cover: "ELECTRICAL", or "COMMUNICATIONS" as applicable. Provided

boxes with hinged, aluminum checkered plate covers with pull-handle to open in non-traffic areas.

3. Provide precast Quazite Compsolite cement/polymer products, or Engineer and Owner approved equal, for handholes, pullboxes, manholes, meter boxes, equipment pads, and vaults where nonvehicular and or paved areas or as specified per project drawings.
4. Electrical manholes and/or handholes shall be installed with open gravel stone bottoms using #57 stone or Engineer and Owner approved equal. A minimum of 2-inch of gravel should be installed and tamped in place before installing handhole or manhole.

E. Raceway and Box Supports:

1. Provide stainless-steel framing channel with end caps to support groups of conduits. Provide individual conduit supports that have one-hole stainless-steel malleable iron pipe straps used with stainless-steel clamp backs and nesting backs.
2. Provide stainless-steel supports, channel, fittings, all-thread, and fasteners in outdoor locations, in corrosive areas, and as shown. Provide factory endcaps for support and channels.
3. Independently support boxes by stainless-steel brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden or plastic plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.

F. Underground Marking Tape:

1. Provide low-density, polyethylene plastic, underground marking tape and install above and centered for early warning protection for digging near electrical ductbanks.
2. Provide Brady "Identoline"; Services and Materials "Buried Underground Tape"; Somerset (Thomas & Betts) "Protect-A-Line"; or Engineer and Owner approved equal. Provide tape with nominal dimension of 6 inches wide, 4-mil thickness.
3. Provide underground marking tape 6-inch wide metallic-lined tape with red polyethylene film on top and with clear polyethylene film on the bottom of the tape for installation above and centered on direct buried cables and conduits without ductbank encasement.
4. Provide black over red marking tape clearly printed with: "CAUTION ELECTRIC LINE BURIED BELOW", or provide OSHA approved marking tape.

G. Nameplates:

1. Provide nameplates for all boxes and enclosures with nameplate wording as shown on the drawings. Provide the tag number or box number with device functional description on device nameplate. Nameplate wording may be changed without additional cost where changes are made during the submittal process or prior to commencement of engraving.
2. Provide machine engraved laminated white phenolic nameplates with black lettering for panel-mounted equipment with the instrument tag number/description in 3/32-inch minimum size lettering and attach to the panel or enclosure with a minimum of two self-tapping 316 stainless-steel screws. Provide nameplates for power sources indicating the power loads and nameplates for power loads that indicate the power sources, in accordance with these specifications and the NEC.

H. Raceway Markers:

1. Provide raceway markers: 0.036-inch minimum thickness, solid brass tags or aluminum tags with raceway number or the circuit number, stamped in 3/16-inch minimum height characters and attach tags to the raceway with 316 stainless-steel wire. Install raceway markers inside of pull boxes, handholes, manholes, and where entering electrical equipment enclosures.
2. Provide raceway markers indicating the power source and circuit number for lighting and receptacle raceways to the associated panelboard. Interior lighting and receptacle raceways do not require raceway markers for conduit between components.

I. Identification Tags:

1. Provide the following:
 - a. Equipment: Typical size 1-inch x 3-inch wide, white with black engraved equipment number and equipment description.
 - b. Raceway/Conduit: Tags with raceway or conduit number or circuit shown.
 - c. Instrument: 1.5-inch wide, aluminum tag with instrument number and description.
 - d. Conductor: Power, control, or instrument cable with the circuit identified as shown; power source or power/control panel identified; power load, equipment, instrument, or device identified; purpose of the conductors identified.
 - e. Fastener: nylon-coated 48-mil stainless-steel wire. Manufacturer: Brady catalog number 23310 or Engineer and Owner approved equal with double ferrule type brass wire clamps. Manufacturer: Brady number 23312.

J. General Raceway Requirements:

1. Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400 feet, less 100 feet for every 90 degrees for the conduit run change in direction.
2. Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes. The RACESPEC sheets with specified requirements begin on the next page.

2.3 RACEWAY SPECIFICATION SHEETS (RACESPEC) - RMC-STEEL

A. Raceway Identification:

1. RMC-Steel

B. Description:

1. Rigid Steel Conduit

C. Compliance:

1. ANSI C80.1, UL 6

D. Finish:

1. Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.

- E. Manufacturers:
 - 1. Allied Tube and Conduit Corp., Wheatland Tube Co., or Engineer and Owner approved equal.
- F. Minimum size:
 - 1. Unless otherwise shown: 3/4-inch for exposed; 1-inch for concealed or embedded; 2-inch for ductbank encased.
- G. Fittings:
 - 1. Hubs:
 - a. Insulated throat with bonding locknut, Hot-dip galvanized. The hubs shall utilize a neoprene "O" ring and shall provide a watertight connection. O-Z Gedney, CHM-XXT, or Engineer and Owner approved equal.
 - 2. Unions:
 - a. Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or Engineer and Owner approved equal. Threadless fittings are not acceptable.
- H. Boxes:
 - 1. Indoor:
 - a. Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-12 welded steel 6 inches square and larger. Door shall have hinges with clamp locks. Boxes in process areas shall be NEMA-4 watertight. Boxes in corrosion areas shall be NEMA-4X.
 - b. Conduit bodies: ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.
 - 2. Outdoor:
 - a. Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square. NEMA-4X stainless-steel nonmetallic for 6 inches square and larger.
- I. Elbows:
 - 1. (3/4-inch thru 2.5-inch)
 - a. Factory fabricated or field bent.
 - 2. (3-inch thru 6-inch)
 - a. Factory fabricated.
- J. Conduit Bodies:
 - 1. (3/4-inch thru 4-inch)
 - a. Malleable iron, Hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for all conduit entrances.
 - 2. (5-inch and 6-inch)
 - a. Electro-galvanized iron or cast-iron box.
- K. Expansion Fittings:
 - 1. Expansion fittings in embedded runs shall be watertight and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.

L. Manufacturers:

1. Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or Engineer and Owner approved equal.

M. Installation:

1. Rigid steel conduit shall be made up tight and without thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using Hot-dip galvanized malleable iron straps with nesting backs.
2. Conduit entering boxes shall be terminated with a threaded hub as specified or standard fittings with grounding bushing.
3. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

2.4 RACEWAY SPECIFICATION SHEETS (RACESPEC) - LFSC

A. Raceway Identification:

1. LFSC

B. Description:

1. Liquid-Tight Flexible Steel Conduit

C. Application:

1. Final connection to equipment subject to vibration or adjustment.

D. Compliance:

1. UL 360

E. Construction:

1. Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.

F. Minimum size:

1. 3/4-inch

G. Fittings:

1. Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.

H. Installation:

1. Do not exceed 36-inch length.

2.5 RACEWAY SPECIFICATION SHEETS (RACESPEC) - RNC40 AND RNC80

A. Raceway Identification:

1. RNC40 and RNC80

- B. Description:
 - 1. Rigid Nonmetallic Conduit, heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage. DZYR per NEC Article 352.
- C. Compliance:
 - 1. NEMA TC2, UL 651
- D. Construction:
 - 1. Schedule 40, high-impact, polyvinyl-chloride (PVC)
 - 2. Schedule 80, high-impact, polyvinyl-chloride (PVC)
- E. Minimum size:
 - 1. 3/4-inch exposed; 2-inch embedded or encased
- F. Fittings:
 - 1. PVC solvent weld type
- G. Boxes:
 - 1. Indoor:
 - a. NEMA Class 4, nonmetallic
 - 2. Outdoor and corrosive:
 - a. NEMA Class 4X, nonmetallic
- H. Installation:
 - 1. PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O-ring. Joints shall be made with standard PVC couplings.
 - 2. PVC conduit shall have bell ends where terminated at manholes, handholes, or building walls. Bell ends shall terminate flush at the walls and floors and not extend or protrude.

2.6 RACEWAY SPECIFICATION SHEETS (RACESPEC) - WW

- A. Raceway Identification:
 - 1. WW
- B. Description:
 - 1. Wireway and Auxiliary Gutter with hinged covers.
 - 2. Match the area classification enclosure type where installed.
- C. Compliance:
 - 1. JIC EMP-1 and NEC Article 366
- D. Minimum size:
 - 1. 4-inch x 4-inch
 - 2. Length as shown or determined by the installation requirements.

- E. Maximum size:
 - 1. Sized in accordance with NEC-366 fill rules
- F. Finish:
 - 1. Smooth finished surfaces.
- G. Application:
 - 1. As shown on the drawings and where required.
- H. Hardware, Supports, Fittings, and Fasteners:
 - 1. Stainless-steel
- I. Fasteners:
 - 1. Quick release 1/4 turn type or suitable for the area classification.
- J. Finish:
 - 1. Aluminum.
- K. Accessories:
- L. Fittings, barriers and covers shall be of the same materials, finish and construction as the straight tray products.

2.7 CONDUCTORS, WIRE, AND CABLE

- A. Provide products specified.
- B. Unscheduled Conductor Sizing:
 - 1. Size conductors, wire, and cables in accordance with the National Electrical Code where not specified on the Drawings and install in the minimum size raceway as specified in the RaceSpecs herein.
 - 2. Provide black insulation conductors larger than #10 AWG with colored 3/4-inch vinyl plastic tape to identify the phase color at each cable termination. Tape wrap with 25 percent overlay to provide minimum of 3 inches of coverage.
- C. Scheduled and Unscheduled Wire and Cable:
 - 1. Provide the insulation and jacket material specified in the CABLESPEC sheets for scheduled and unscheduled (not shown) conductors. Provide stranded copper conductors for all wire and cable.
- D. Electrical Enclosure Conductor Ratings:
 - 1. Provide conductors with 600-volt insulation ratings in panels and other electrical enclosures. Conductors with less than 600-volt insulation ratings are prohibited, unless specifically identified.
 - 2. Bundle and lace conductors in panels and electrical equipment at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Provide lacing using plastic cable ties that are tensioned and cut off using a tool

specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are prohibited.

3. Bundle conductors crossing hinges into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors and provide oversized plastic panel wiring duct within panels.
4. Provide slack in junction boxes, pull boxes, handholes and manholes sufficient to allow cables or conductors to be routed along the walls with the amount of slack equal to largest dimension of the enclosure.
5. Provide dedicated electrical wireways and insulated cable holders mounted and secured on stainless-steel Unistrut in manholes and handholes.

E. Instrument Signal Cable: Not Used

F. Splicing and Terminating Materials:

1. Use an UL listed tool for the applied compression type of connectors with the correct size and type. Provide tin-plated high conductivity copper connectors. Mechanical clamp, dimple, screw-type connectors are prohibited.
2. Provide polymeric insulating material over motor terminations with high dielectric strength mastic or material to seal the ends against ingress of moisture and contamination.
3. Cover splices with electrical products designed for the application and insulate with a heat-shrinkable sleeve or boot.

2.8 CABLE SPECIFICATION SHEETS (CABLESPEC)

A. CABLESPEC Sheets

1. The following CABLESPEC sheets are included in this section:

Type	Volt	Product	Purpose
XHHW	600	XLP Insulated Industrial Grade Conductor	Power cable
THWN-2	600	Building Wire, Control Wire	Lights, receptacles, control wire

2.9 CABLE SPECIFICATION SHEETS (CABLESPEC) – XHHW

A. Cable System Identification:

1. XHHW

B. Description:

1. Industrial grade single conductor
2. Sizes: 14 AWG through 750 kcmil as shown

C. Voltage:

1. 600 volts

D. Conductor Material:

1. Bare annealed copper; stranded per ASTM B8

- E. Insulation:
 - 1. NEC Type XHHW-2, 90 degrees C dry or wet, Cross-Linked Polyethylene (XLP) per ICEA S-66-524 and UL-44, Color in sizes 14, 12 and 10 AWG: Black, Green, Yellow, White, Orange, Brown, Red, Blue
- F. Jacket:
 - 1. None
- G. Flame Resistance:
 - 1. UL 83
- H. Manufacturer(s):
 - 1. Okonite, X-Olene; Cablec, Durasheath XLP; or Engineer or Owner approved equal.
- I. Uses Permitted:
 - 1. Power, control, lighting and outlet circuits.
- J. Execution:
 - 1. Installation:
 - a. Install in accordance with Section 26 05 00.01.
 - 2. Testing:
 - a. Test in accordance with paragraph 26 05 00.01-3.02 and Section 26 05 00.01.

2.10 CABLE SPECIFICATION SHEETS (CABLESPEC) – THWN-2

- A. Cable System Identification:
 - 1. THWN-2
- B. Description:
 - 1. Single conductor lighting and receptacle type indoor branch circuit conductor. Sizes: 12 AWG through as shown.
- C. Voltage:
 - 1. 600 volts
- D. Conductor Material:
 - 1. Bare annealed copper; stranded in accordance with ASTM B3 or B8
- E. Insulation:
 - 1. THWN/THHN, 90 degrees C dry, 75 degrees C wet, polyvinylchloride (PVC) with nylon jacket per UL 83.
 - 2. May substitute XHHW2 with XLP insulation without a jacket.
- F. Jacket:
 - 1. Nylon
- G. Flame Resistance:
 - 1. UL 83

- H. Manufacturer(s):
 - 1. Okonite, Okoseal-N, series 116-67-XXXX; or Engineer or Owner approved equal.
- I. Uses Permitted:
 - 1. Lighting, receptacle, appliance circuits and control, no other location permitted
- J. Execution:
 - 1. Installation:
 - a. Install in accordance with Section 26 05 00.01
 - 2. Testing:
 - a. Megger Test: use Form in Section 01 99 90

2.11 WIRING DEVICES

- A. Unless specified otherwise, provide UL approved wiring ivory devices for the current and voltage ratings specified and comply with NEMA WD-1 with provisions for back wiring and side wiring with captive held binding screws.
- B. Heavy Duty 120v Receptacles:
 - 1. Ground Fault Interrupting: Ground fault interrupting (GFI) receptacles: duplex, 20 amp, NEMA 5-20R, specification grade that accepts NEMA 5-15P and 5-20P plugs. Provide GFI receptacles outdoors and as shown, UL listed with provisions for testing and resetting. Manufacturer: Hubbell GF-5352-I, or Engineer and Owner approved equal.
- C. Switches:
 - 1. Switches: Quiet AC type, heavy duty, specification grade in accordance with rated capacities as required. Match the switch color and the receptacles color. Manufacturer: Cooper, Hubbell, or Engineer and Owner approved equal.
- D. Device Plates: Provide device plates with switches and receptacles that match the area classification location.
 - 1. Wet/Corrosive Switch Covers: In outdoor areas, wet areas, areas designated NEMA-4X, Corrosive, or other areas specified, provide weatherproof, corrosion-resistant covers for switches to maintain weatherproof rating during operation of switch. Covers shall have flexible bubble of silicone or neoprene rubber for switch operation. Manufacturer: Cooper, Hubbell, or Engineer and Owner approved equal.

2.12 GROUNDING SYSTEM

- A. Elevated Storage Tank ground systems shall be coordinated with the tank supplier.
- B. Provide electrical system grounding electrode conductors, equipment grounding conductors for equipment grounding and raceways, grounding electrodes, grounding electrode conductors, connections, and bonding in compliance with the National Electrical Code-Article 250 and the National Electrical Safety Code.
- C. Provide annealed bare copper, concentric stranded grounding conductors. Provide the minimum sizes per NEC Article 250 for grounding conductors or service entrance conductors, if not sized on the drawings.

- D. Bond grounding conductors entering enclosures together to metallic enclosure and to metallic raceways terminating at the enclosure. Clean the conductor and enclosure metal surface at the point of connection prior to making equipment grounding connections or bond connections.
- E. Provide ground grid components of #4/0 AWG bare copper conductors connected to 10-foot ground rods installed at the four corners of a building, an equipment pad, or as shown on the Drawings. Provide UFER, concrete-encased electrodes per NEC 250.52(3), by embedding conductors in concrete near bottom of footing.
- F. Make connections grounding conductor connections to equipment and ground rods by bolted clamps, compression connectors, or exothermic weld connections in accordance with manufacturer's installation and testing instructions. Make connections to buried grounding connections using compression connectors or exothermic weld connections. Make connections at the ground grid test wells using bolted clamps.
- G. Connect the ground grid to the following with grounding conductor specified herein or connect to the ground grid with grounding conductor as shown on the drawings:
 - 1. Building steel columns with #4/0 AWG bare copper
 - 2. Electrical ductbank #4/0 embedded conductor with #4/0 bare copper
 - 3. Electrical distribution or utilization equipment metal enclosures with #4/0 AWG green insulated copper
 - 4. Metal enclosure not containing electrical distribution with #4 AWG green insulated copper
 - 5. Pump/motor frames with #4 AWG bare or insulated
 - 6. Lightning and surge arresters using #4 AWG bare or insulated
 - 7. Fences and gates with #4 AWG bare or insulated
 - 8. Ground rods with #4/0 AWG bare copper
 - 9. Power utility service entrance equipment with #4/0 bare copper
 - 10. Equipment ground plate with #4/0 AWG bare copper.
 - 11. Other equipment: provide #1 AWG green insulated copper. Provide 3/4-inch conduit protection where subject to damage.
- H. Ground Rods:
 - 1. Ground rods: copper-clad steel, 3/4-inch diameter and 10-feet long, with threaded end for connectors or installation tools.
- I. Compression Connectors:
 - 1. Compression connections: cast copper.
 - 2. Manufacturer: Thomas & Betts Company, or Engineer and Owner approved equal.
- J. Bolted Connectors:
 - 1. Bolted connectors: copper. Manufacturer: Burndy, O. Z. Gedney, or Engineer and Owner approved equal.
- K. Exothermic Connectors:
 - 1. Exothermic connections copper products. Manufacturer: Cadweld process or Engineer or Owner approved equal.

L. Raceway Ground:

1. Install metallic conduits to provide a continuous ground path. Use insulated grounding bushings and bonded to the ground grid system in compliance with Article 250 of the National Electrical Code.
2. Provide an equipment-grounding conductor with green insulation in all metallic and non-metallic conduit, raceway, wireway, gutter, or ductbanks.
3. Provide an equipment grounding conductor with green insulation for size up to #6 AWG and provide green color insulation tape band for conductor size #4 AWG and larger.

2.13 POWER, CONTROL, AND METERING EQUIPMENT

A. Coordinate any demolition of existing equipment and installation of new equipment.

B. Panelboards:

1. Provide panelboards: circuit breaker, dead front type with bus bar construction composed of individually mounted circuit breakers with screw-connection, designed to be removed without disturbing other breakers. Provide lockable, hinged door-in-door construction for flush mounted panels and hinged-trim covers for surface mounted panels.
2. Provide tin-plated copper buss and with the current rating as shown on the panel schedules sized in accordance with UL 67 and withstand rating equal to the interrupting rating of the smallest circuit breaker in the panel. Series rated products are prohibited. Silver plated equipment is prohibited.
3. Provide panelboards with a separate ground bus and a full capacity neutral bus. Mount neutral bus on insulated standoffs. Provide removable link connector from the neutral bus to the ground bus. Provide listed and labeled panelboard for service entrance disconnect as shown.

C. Circuit Breakers:

1. Provide circuit breakers: molded-case type provided for the current ratings and pole configurations as shown or as specified on the panelboard schedule and with a minimum interrupting current rating as shown on drawings or schedules, but not less than 22,000 AIC for 240 volt rated devices. Series rated branch, main, or other devices are prohibited.
2. Provide circuit breakers listed in accordance with UL 489 for the service specified and load terminals with solderless connectors. Provide bolt-on type circuit breakers. Provide circuit breakers with machine-printed circuit number labels indicating the load served.

2.14 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00:

1. Operating and maintenance information as specified in Section 01 78 23.
2. One 11-inch x 17-inch set of drawings in a protective covering and shipped with the equipment in the internal equipment pocket at the time of equipment delivery to the project site.
3. Record documents as specified in Section 01 78 39.

4. Certificates of final electrical inspection and approval from the Code Authority Having Jurisdiction (AHJ) as specified in paragraph 26 05 00.01-1.01 A 4.

PART 3 – EXECUTION

3.1 GENERAL

A. Construction:

1. Perform the work specified by Contract Documents in accordance with these specifications.
2. Coordinate the location of electrical material or equipment with the work and adjust conduit location to accommodate equipment in accordance with the accepted submittal drawings from the manufacturer.
3. Electrical site work shall be coordinated with the Owner. There is significant duct bank work on this project, which will require coordination with the Owner for connections to existing and future equipment. Contractor shall install conduit, manholes and handholes as shown. Routes and locations are generally shown on the drawings. The Contractor shall finalize and confirm all locations and routes with the Owner prior to installation.
4. All empty conduits installed for future use by the Owner shall be capped as specified here and shall include a pull string.

B. Housekeeping:

1. Protect electrical equipment from dust, water, and damage. Cover the exterior to keep dry. Electrical distribution equipment such as motor control centers, switchgear, switchboards, panelboards, and other power source buses shall be clean and free of dust and dirt.
2. Protect electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction as specified in Shipment, Protection, and Storage section. Touch up scratches on equipment as specified in Coating Systems section before final acceptance.
3. Wipe clean and vacuum equipment on the inside prior to acceptance testing and energization and again prior to detailed inspection and acceptance of the work.

C. Installation:

1. Perform the installation work specified in accordance with these specifications.
 - a. Splices are not allowed except by permission. Submit proposed splice locations to the Engineer and Construction Manager for review prior to installation. Splices and terminations are subject to inspection prior to and after insulating and may require re-termination after inspection. Underground splices will not be allowed.
 - b. Lighting and receptacle circuits may be in the same conduit in accordance with derating requirements of the NEC. Lighting and receptacle circuits in conduits with power or control conductors is prohibited.
 - c. Adhere to the NEC raceway fill limitations. Provide separate conduits for signal and instrument conductors and cables.
 - d. Install pre-approved in-line splices and tees with tubular compression connectors and insulate. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin splicing kits.

D. Conductors, Wire, and Cable Installation:

1. Identify conductors at each connection terminal and at splice points with the identification marking system specified.
2. Install wire and cable into raceways, conduit, cable trays, or wireways without damaging or putting undue stress on the insulation or jacket. Provide manufacture's recommended and UL Listed pulling compounds lubricants for pulling wire and cable. Grease is prohibited.
3. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed.
4. Adhere to raceway fill limitations defined by NEC and the following: Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits.
5. Install pre-approved in-line splices and tees made with tubular compression connectors and insulated as specified for terminations and for motor terminations. Splices and tees in underground handholes or pull boxes shall be insulated using Scotch-cast epoxy resin or Engineer and Owner approved equal splicing kits.
6. Conductors in all handholes and manholes shall have adequate slack to be tied up around the perimeter of the vault and will be suspended by insulators around the vault's perimeter as needed to support the cable.

E. Raceway Installation:

1. Provide additional pullboxes for conduit runs with greater than 360 degrees in any run between pull boxes. Limit maximum conduit runs without additional pullboxes to 400 feet, less 100 feet for every 90 degrees for the conduit run change in direction.
2. Determine conduit routing that conforms to the installation requirements set forth herein and in accordance with the NEC requirements for size and number of pullboxes.
 - a. Install exposed conduit either parallel or perpendicular to structural members and surfaces.
 - b. Route two or more exposed conduits in the same general routing parallel with symmetrical bends.
 - c. Install exposed conduit on supports spaced not more than 10 feet apart.
 - d. Install conduits out from the wall using framing channel where three or more conduits are located in parallel run.
 - e. Install conduits between the reinforcing steel in walls or slabs that have reinforcing in both faces.
 - f. Install conduit in slabs that have only a single layer of reinforcing steel, under the reinforcement.
 - g. Install conduits with large radii under the slab in a one-sack concrete slurry.
 - h. Route conduits clear of structural openings and show future openings.
 - i. Grout conduit into any openings cut into concrete and masonry structures.
 - j. Cap conduits during construction to prevent entrance of dirt, trash, and water.
 - k. Terminate exposed conduit stubs for future use with pipe-caps and provide couplings and pipe-plugs where flush with the slab.
 - l. Determine concealed conduit stub-up locations with the Owner.

- m. Terminate conduit in equipment with conduit couplings with pipe-plugs flush with structural surfaces for empty conduit.
- n. Install conduit horizontally with at least 7-feet headroom clearance.
- o. Terminate conduit with fittings that ensure that the NEMA rating of the enclosure and provide conduit hubs, as required heretofore.
- p. Connect underground metallic or nonmetallic conduit that turns out of concrete, masonry, or earth to a 90-degree elbow of PVC-coated rigid steel conduit before emergence. Taped or painted RMC-Steel or RNC is prohibited.
- q. Provide conduit crossing structural joints with structural movement with O-Z "Type DX" or Crouse-Hinds "Type XJG-SA," aluminum, bonded, weather-tight expansion fitting of the same size and type as the conduit.
- r. Seal conduits in corrosive areas using removable mastic material.

F. Underground Raceway Installation:

- 1. Provide underground conduit installations that conform to the following requirements:
 - a. Direct bury underground conduits that are not shown to be installed in an electrical ductbank.
 - b. PVC coated RMC-steel elbows for underground to above ground transitions.
 - c. Underground conduit bend radius: not less than 2 feet minimum at vertical risers nor less than 3 feet elsewhere for up to 2-inch diameter conduit.
 - d. Determine conduit manufacturer's bending radius requirement for 3-inch and larger diameter conduit and use factory "long radius" ells.
 - e. Underground ductbanks and direct-buried conduits: 2-feet minimum earth cover, except where shown otherwise.
 - f. Concrete encased conduit:
 - 1) Minimum concrete thickness of 2 inches between conduits 2.5-inch and smaller.
 - 2) 3 inches between 3-inch conduit and larger or per NEC requirements.
 - 3) 1-inch between conduit and reinforcing.
 - 4) 3 inches over reinforcing.
 - 5) Embed #4/0 bare ground in the concrete encasement and installed with direct buried raceways.
 - 6) Standard detail or typical details shown supersede these general requirements.
 - 7) Provide 467-ASTM coarse aggregate size with 3-cement sacks per cubic yard concrete.
 - 8) Provide concrete with 28-day, 2000-psi compressive strength unless specified at higher value in the cast-in-place concrete specification.

G. Electrical Equipment Labeling – Arc Flash

- 1. Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection. These labels will be provided by the Contractor.

3.2 TESTING

- A. Test lighting system for proper function. Test wiring devices for correct connections. Test outlet grounding and polarity using a plug-in test device.
- B. Test power, control, instrument, and signal conductors to verify free from grounds. Megger test all conductors with the test voltage appropriate to the conductor insulation voltage. Use a 600 or 1,000-volt megohmmeter for resistance measurements for 600VAC rated insulation and all motors. Test between conductors and from conductor to ground. Insulation with resistance of less than 10-megohms is not acceptable. Record the insulation resistance measurements in a format similar to or on the Form 26 05 00.01-A in Section 01 99 90.
- C. Pre-test conductors prior to installation, as appropriate. Replace damaged conductors. Test all conductors after installation.

3.3 FUNCTIONAL CHECKOUT

- A. Prior to energization of equipment, perform a functional checkout of the control circuit. Prior to functional testing, adjust and make protective devices operative. Energizing each control circuit and operating each control, status, alarm, protective device, and each interlock to verify that the specified action occurs. Submit a description of his proposed functional test procedures prior to the performance of functional checkout.

3.4 GROUNDING SYSTEM TESTS

- A. Test each grounding connection to determine the ground resistance per the IEEE Standard 81. Submit a plot of ground resistance readings for each isolated ground rod or ground mat to the Construction Manager on 8-1/2 x 11-inch size graph paper.
- B. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. Make measurements at 10-foot intervals, beginning 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.
- C. A grounding system that shows greater than 2-ohm resistance, for the flat portion of the plotted data, is considered inadequately grounded. Add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2-ohm requirement. Additional ground rods and ground grid work will be paid for as extra work. Use of salts, water, or compounds to attain the specified ground resistance is prohibited.

3.5 RECORD DOCUMENTS

- A. Provide Record Drawings and documents maintained and annotated during construction. Submit drawings in accordance with Section 01 78 39 and the following.
- B. Include addendum items, requests for information, change orders, and field changes posted or drawn on the Record Drawings. Include the following drawings with the Record Drawings:
 - 1. Interconnection Diagrams specified herein.

2. Original Submittal Drawings specified herein.
- C. Submit Record Drawings and Operations and Maintenance (O&M) Manuals as specified in Sections 01 78 23 and 01 78 39, to be included in the completed project Record Document Set for the Owner.

END OF SECTION

SECTION 26 09 13

ELECTRICAL POWER MANAGEMENT SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. The work under this specification consist of furnishing, installing, testing, FCC licensing and commissioning Remote Terminal Units (RTU) in accordance with Brunswick-Glynn County Joint Water & Sewer Commission Supervisory Control and data Acquisition (SCADA) System specifications for monitoring and/or controlling the listed I/O requirements.
- B. New RTU shall be provided for the elevated water tank
- C. The General Contractor is responsible for all work of this section. The telemetry and instrumentation work is not a separate contract.
- D. Related Sections
 - 1. Division 26 05 00.01

1.2 SUBMITTALS

- A. The following information shall be provided prior to fabrication and shipment of any specified items in this section:
 - 1. RTU Panel Layout Drawings
 - 2. Component Catalog Cuts
 - 3. Wiring Diagrams
 - 4. Display Screen Layout for addition to the existing system master.

1.3 GENERAL

- A. All equipment supplied under this specification shall be totally compatible and integrate successfully with the existing system. Operation protocols, hardware including logic controllers and radio transceivers, control logic programming special features and spare parts shall be compatible to the existing system. Additionally, as part of this Specification the supplier shall provide all modifications, additions, deletions and/or software developmental requirements to successfully integrate the additional RTU to the existing Man-Machine Interface (MMI) software system and Workstation hardware.

1.4 RTU HARDWARE

- A. RTU hardware shall be CAT# ESC-4141-GLY Remote Terminal Unit. The unit shall include the enclosure, controller, radio transceiver, aluminum antenna, aluminum antenna mast, power supply and miscellaneous cables.

1.5 INPUTS/OUTPUTS

- A. The RTU shall monitor and control points (I/O) the following:
 - 1. Storage Tank Level
 - 2. Distribution system pressure transmitter
 - 3. Altitude valve limit switch (open-closed)

4. Power failure relay
- B. The RTU shall process display and alarm the following:
 1. Current storage level status
 2. Tank high-level alarm
 3. Tank low-level alarm
 4. Current distribution pressure status
 5. Distribution high-pressure alarm
 6. Distribution low-pressure alarm
 7. Altitude valve status (open-close)
 8. Power failure alarm
 9. SCADA Communication failure alarm
 10. Tamper/Intrusion alarm

1.6 RTU HARDWARE

- A. The telemetry supplier shall provide services to install, connect, test, and put in operation all the equipment supplied under this section.
- B. The telemetry supplier shall provide services to add the necessary software to the existing Master Station to integrate the elevated water tank cover under this project.

END OF SECTION

DIVISION 31

EARTHWORK

31 10 00	Site Preparation
31 23 00	Excavation and Fill
31 23 19	Dewatering
31 25 00	Erosion and Sedimentation Control
31 41 00	Sheeting, Shoring, and Bracing

SECTION 31 10 00
SITE PREPARATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping, or sealing, and removing site utilities
 - 7. Temporary erosion and sedimentation control measures.
- B. Related Sections:
 - 1. Division 01
 - 2. Division 02
 - 3. Division 31

1.3 DEFINITIONS

- A. Subsoil:
 - 1. All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.
- B. Surface Soil:
 - 1. Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil:
 - 1. Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.
 - 2. Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches (50 mm) in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone:

1. Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone:

1. Area surrounding individual trees or groups of trees is to be protected during construction and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

F. Vegetation:

1. Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

A. Existing Conditions:

1. Documentation of existing trees and plantings, adjoining construction, and site improvements that establish preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - a. Use sufficiently detailed photographs or videotape.
 - b. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings:

1. Identifying and accurately showing locations of capped utilities and other structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference:

1. Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic:

1. Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - a. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - b. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: (NOT USED)

- C. Salvable Improvements:
 - 1. Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service:
 - 1. Utilize a utility locator service for area where Project is located before site clearing.
 - 2. Do not commence site clearing operations until temporary erosion and sedimentation control and plant-protection measures are in place.
 - 3. The following practices are prohibited within protection zones:
 - a. Storage of construction materials, debris, or excavated material.
 - b. Parking vehicles or equipment.
 - c. Foot traffic.
 - d. Erection of sheds or structures.
 - e. Impoundment of water.
 - f. Excavation or other digging unless otherwise indicated.
 - g. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
 - 4. Do not direct vehicle or equipment exhaust towards protection zones.
 - 5. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- E. Soil Stripping, Handling, And Stockpiling:
 - 1. Perform only when the topsoil is dry or slightly moist.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material:
 - 1. Requirements for satisfactory soil material are specified in Section 31 23 00 – Excavation and Fill.
 - a. Obtain approved borrow soil material off-site from the Engineer and Owner when satisfactory soil material is not available on-site.
- B. Antirust Coating:
 - 1. Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain.

- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion and sedimentation control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion and sedimentation control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General:
 - 1. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Engineer.

3.4 EXISTING UTILITIES

- A. Contractor will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Contractor will arrange to shut off indicated utilities.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities:
 - 1. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - a. Notify Owner and Engineer not less than two days in advance of proposed utility interruptions.
 - b. Do not proceed with utility interruptions without Owner or Engineer's written permission.
 - 2. Excavate for and remove underground utilities indicated to be removed.
 - 3. Removal of underground utilities as included on the drawings.

3.5 CLEARING AND GRUBBING

- A. The sites of all excavation and grading shall be first cleared of all paving, trees, stumps, roots, brush, organic matter, crops, paving, structures, fences, sidewalks, rubbish, debris, etc., which shall be removed or disposed of in a satisfactory manner in a legally permitted location at no additional cost to the Owner.
- B. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated. When it is necessary to cut tree roots on the surface of the ground, the ends shall be cut off smooth, without splitting or shattering and scars greater than one inch in diameter shall be sealed with an approved asphalt sealant tree paint. The trunks of the trees shall be carefully protected from damage, and if unavoidable damage occurs, the injured portions shall be neatly trimmed and covered with an application of an approved asphalt sealant tree paint. Excavating machinery, cranes, etc., shall be handled with care to prevent damage to trees, particularly to overhanging branches, and branches shall not be cut off except by permission of Owner.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within protection zones.
 - 4. Chip removed tree branches and stockpile in approved areas or disposed of offsite, as directed by Owner.
- C. Grub and remove stumps and roots to a depth not less than two feet (2-feet) below grade. Fill depressions caused by clearing and grubbing operations with proper backfill soil material unless further excavation or earthwork is indicated by the Drawings or directed by Owner. Place fill material in horizontal layers or lifts, not exceeding a loose depth of eight (8) inches and compact each layer to 85 percent of maximum dry density – Standard Proctor (ASTM D698).
- D. Grub, stockpile, and/or place in embankments surface rocks and boulders from the soil in accordance with the Specifications.
- E. Grub the entire construction area with heavy tractors with root rakes. Generally, conduct raking along the contour rather than up and down slopes so as to inhibit soil erosion.
- F. Grubbing shall consist of completely removing roots, stumps, trash, and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.
- G. Burying of residual materials will not be allowed.
- H. Burning of debris will not be allowed. It is the Contractor's responsibility to remove all construction debris from the jobsite at no additional cost to the Owner.

3.6 TIMBER

- A. Salvage all timber within cleared area having a marketable value.
- B. The timber within the cleared area shall become the property of the Contractor and the Contractor shall be responsible for selling the timber.

3.7 DISPOSAL OF CLEARED AND GRUBBED MATERIALS

- A. Dispose of the cleared and grubbed materials by burning or chipping. Burning shall be permitted during approved burning seasons only. During non-burning season periods, use chipping for debris disposal. Remove chipped material from the site or dispose of in areas approved by Owner.
- B. If burning is allowed, do not allow a fire to be unattended. The Contractor is responsible for damage occasioned by such fires. Do not bury burned and nonflammable materials.
- C. Disposal of materials in streams will not be permitted. Do not pile materials in stream channels or along the banks where it might be washed away by flood.
- D. Remove all fence material within the areas to be cleared from the job site. Fence materials become the property of the Contractor.

3.8 DISCING

- A. After grubbing is complete, discing of the entire area is required. Perform discing in two directions at approximate right angles. Generally, perform the second discing along the contour.
- B. The construction area is to be left free-draining with a finished agricultural appearance.

3.9 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to a depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for resspreading deeper topsoil.

3.10 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
 - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION

SECTION 31 23 00
EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	<u>Title</u>
1.2	Submittals
1.3	Quality Assurance
1.4	Field Conditions
1.1	Bedding
1.2	Backfill
1.3	Top Soil
1.4	Initial Site Preparation
1.5	Protection of Trees and Shrubbery
1.6	Dewatering
1.7	Sheeting, Shoring, and Bracing
1.8	Excavation
1.9	Blasting
1.10	Unauthorized Excavations
1.11	Bedding
1.12	Backfilling
1.13	Fills and Embankments
1.14	Disposal of Waste and Unsuitable Materials/Debris Removal
1.15	Spoil Removal
1.16	Storage of Materials
1.17	Additional Excavation
1.18	Final Grading
1.19	Top Soil
1.20	Settlement
1.21	Access by the Owner's Material Testing Firm

B. Scope

1. The work covered by this section includes furnishing all labor, materials, and equipment required for all earthwork and earthwork related operations including, but not limited to, dewatering; excavating all classes of material encountered on the construction site; pumping, draining, and handling of water encountered in the excavations; handling, storage, transportation, and disposal of all excavated and unsuitable material; handling, storage, and transportation of all off-site borrow excavation; construction of fills and embankments; backfilling around structures and pipe; backfilling all trenches and pits; compacting; sheeting, shoring and bracing; preparation of subgrades; surfacing and grading, and all other appurtenant earthwork operations which may be necessary to complete the work as specified herein and as shown on the drawings.

C. General

1. The term “excavation” as used herein shall mean excavation of materials including earth, hardpan, rock, masonry, concrete – plain and reinforced, pavement, ashes, rubbish, muck, debris, etc.
2. Perform earthwork operations in a safe and proper manner with appropriate precautions being taken against all hazards.
3. Maintain all excavated and filled areas for structures, trenches, fills, topsoil areas, embankments, and channels in good condition at all times until final acceptance by the Owner. Repair all damage caused by erosion or other construction operations using material of the same type as the damaged material.
4. Perform earthwork within the rights-of-way of the State Department of Transportation, the County Department of Transportation, and the respective cities in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these specifications.
5. Control grading in a manner to prevent water running into excavations. Avoid obstruction of surface drainage and provide means whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Provide free access to all fire hydrants, water valves, and meters.
6. No classification of excavated materials will be made. Excavation work includes the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
7. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and flood plains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. Provide all services, labor, equipment, and materials necessary or convenient to complete the work within the time specified in these Contract Documents.

1.2 SUBMITTALS

- A. Submit for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, all working drawings and schedules of materials and methods proposed to be followed in the execution of the Work under this item.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Requirements

1. Perform all earthwork operations in compliance with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations.

B. Field Testing

1. An independent testing laboratory will conduct tests for compaction and density, in each fill layer at intervals of approximately three hundred feet (300'). Depending on field conditions and results of testing, frequency of testing may be increased or

decreased to ensure proper compaction. Make all necessary excavations and supply any samples of materials necessary for conducting compaction and density tests. Costs of compaction tests performed by an independent testing laboratory shall be paid by Contractor. The cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents shall be paid by the Contractor.

1.4 FIELD CONDITIONS

A. Existing Conditions

1. The elevations shown on the Drawings as existing are intended to give reasonable, accurate information about the relative elevations. They are not precise, and the Contractor should satisfy himself as to the exact quantities of excavation and fill required.

PART 2 PRODUCTS

2.1 BEDDING

- A. Unless otherwise specified, bedding material shall be angular, graded, crushed stone embedment and shall conform to Georgia DOT Specification Section 800 Gradation #57, varying in sizes 1/4-inch through 3/4-inch.

2.2 BACKFILL

- A. Provide materials for backfill conforming to the following requirements:

Select Earth Backfill	Fine, sound, loose earth containing optimum moisture content for compaction to 95 percent of maximum density (Standard Proctor ASTM D698), free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete less than 2 inches in maximum dimension except that the maximum particle size shall be 3/4-inch when used with PVC or other flexible thermoplastic pipe; provided material has been approved for such use by construction material testing firm.
Common Earth Backfill	Sound, loose earth containing optimum moisture content for compaction to 95 percent of maximum density (Standard Proctor ASTM D698), free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete and pavement less than 6 inches in maximum dimension.
Sand	Natural or imported sand conforming to ASTM D1073.
Graded Aggregate	Graded aggregate conforming to Sections 310 and 815.01, Class A, Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges.
Class A Concrete	Class A concrete as specified in the section entitled "Cast-in-Place Concrete" of these Specifications.

2.3 TOP SOIL

- A. Top soil is defined as the surface layer of soil and sod that is suitable for use in seeding and planting. No refuse or any material toxic to plant growth is allowed in top soil.

PART 3 EXECUTION

3.1 INITIAL SITE PREPARATION

- A. Preparatory to the beginning of construction operations, remove from the project area all vegetable growth, trees, brush, stumps, roots, debris, and any other objectionable matter, including fences, buildings, and other structures shown on the Drawings in the construction areas which are designated for removal or which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Whenever the removal of pavements (other than gravel or surface treated types) is required, the Contractor shall outline the area to be removed by making straight saw cuts and providing vertical cuts in straight lines in order to permit removal in a straight line. Should pavement breakage occur beyond original saw cut, Contractor will be required to make a new straight saw cut beyond the furthest point of breakage.
- C. Clear and grub the site in accordance with specifications – Clearing and Grubbing of these specifications.
- D. In all areas to be excavated, filled, paved, or graveled, strip the top soil to its full depth and store it on site for subsequent reuse. Keep top soil separate from other excavated materials. Screen out and/or remove roots and other undesirable materials from top soil. Stored topsoil shall be used for finish grading in unpaved areas.
- E. Remove and dispose of all excess material resulting from clearing or site preparation operations. Dispose of such materials in a lawful manner and at a location where such materials can be lawfully disposed.

3.2 PROTECTION OF TREES AND SHRUBBERY

- A. Contractor shall be responsible for protection of tops, trunks, and roots of existing trees that are to remain on the project site or in parks, lawns, or other improved areas. Do not disturb and provide protection, if necessary, for all trees in areas where there is no excavation or embankment. Box, fence, or otherwise protect existing trees, which may be subject to construction damage, before any work is started. Remove the boxing when directed or at the completion of the project. Heavy equipment or stockpiles will not be permitted within branch spread. Remove interfering branches without injury to trunks and cover the scars with tree paints.
- B. Do not remove a tree unless absolutely necessary for construction, as approved by the Engineer or Owner. In areas beyond construction, right-of-way, or easements do not remove trees or shrubbery without the written consent of the property owner and approval of the Owner.

- C. In open or improved lawn areas, excavation is to be done, if possible, utilizing a tractor mounted backhoe. Take extreme care to avoid any damage to adjoining lawn areas. In areas not readily accessible by machinery and where excavation is required near existing trees and shrubberies, which may be damaged by excavation equipment, excavate the trench with hand tools except as provided is in this section. As an alternate method, bores under landscaped areas may be approved by Owner to minimize disturbance of existing vegetation. This method of construction will be considered as convenience for the Contractor, and shall be paid the same as an open-cut excavation.

3.3 DEWATERING

- A. Provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Accomplish dewatering by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or other suitable methods which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches provided such ditches are kept open and free-draining at all times.
- B. Unless specifically authorized by the Engineer, do not place concrete or mortar in water nor allow water to rise over newly-placed concrete or mortar for at least 24 hours after placement. Do not expose concrete structures to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Ground water encountered within the limits of excavation shall be lowered to an elevation not less than twelve inches (12-inch) below bottom of excavation before pipe laying or concreting is started. Exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Commence dewatering operations when ground or surface water is first encountered and continue until such times as water can safely be allowed to rise in accordance with the provisions of this section. Protect excavations from the entrance of surface water to the extent possible by the use of dikes and/or covers.
- C. Provide and maintain standby pumping equipment on the job site. Make available a minimum of one standby unit (a minimum of one for each ten in the event well points are used) for immediate installation should any pumping unit fail. Design and install well points or deep wells suitable for the accomplishment of the work and in compliance with all local codes.
- D. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, excavate and replace the affected areas with crushed rock at no cost to the Owner.
- E. Dispose of the water from the work in a suitable manner without damage to adjacent property. Do not allow conveyance of the water to interfere with traffic flow or facilities operation. No water shall be drained into work built or under construction. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- F. Provide sedimentation and desilting basins as necessary to prevent the entrance of excessive or injurious amounts of sand and silt from surface runoff or dewatering

operations into storm drains or receiving waters. At a minimum, provide a baffled structure having not less than five minutes' detention time designed to have a "flow-through" velocity not exceeding 0.2 foot per second at the anticipated peak flow for desanding or desilting the water.

- G. Dispose of water in such a manner as not to be a menace to the public health and in accordance with applicable Environmental Protection Agency, Corps of Engineers, and State Environmental Protection Division standards and permits.
- H. Should sewage or any other odorous liquids be encountered during the Work, Owner shall be notified immediately. Owner will promptly notify appropriate regulatory agencies, if necessary. In addition, Owner will instruct Contractor as to any actions the Contractor can and cannot perform prior to any directives, which may be issued by the regulatory agencies. Any sewage will be pumped and hauled to an in-service manhole, pump station, or water reclamation facility, as directed by Owner. Any other liquids will be disposed of properly, as directed by Owner and/or any regulatory agencies having jurisdiction. Owner will then determine if actions taken by Contractor have caused the source of the odorous liquid to leak, and if so, Contractor shall be responsible for any fines and/or penalties levied by regulatory agencies having jurisdiction.

3.4 SHEETING, SHORING, AND BRACING

- A. Contractor shall sufficiently sheet, shore, and brace the sides of all excavations, as necessary, to prevent slides, cave-ins, settlement, or movement of the banks, to maintain the excavation clear of all obstructions, and to provide safe working conditions. Use wood or steel sheeting of approved design and type in wet, saturated, or flowing ground. Design all sheeting, shoring, and bracing with sufficient strength and rigidity to withstand the pressure exerted and to maintain shape and position under all circumstances.
- B. It is the Contractor's responsibility for correctly assessing the need for sheeting and analyzing the stresses induced. Since the Engineer does not dictate or determine the Contractor's sequence or limits of excavation, the Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Submit the results of sheeting and shoring analysis and design to the Engineer on request.
- C. Adequately sheet, shore, or brace excavations adjacent to existing or proposed buildings and structures, or in paved streets or alleys to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpin adjacent structures when necessary to maintain structures in safe condition. Repair any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes; due to failure or lack of sheeting or bracing, or due to improper bracing; or occurring through negligence or fault of the Contractor in any other manner at his own expense.
- D. Do not leave sheeting, shoring, or bracing materials in place unless otherwise specified or shown on the Drawings or ordered by the Engineer in writing. Remove such materials in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Leave trench sheeting in place until backfill has been brought to a level 12

- inches above the top of the pipe. Then cut off and remove the upper portion. Leave sheeting for structures in place until backfill has been brought to a level of 12 inches above the top of the bottom footing. Then cut off and remove the upper portion.
- E. Where in the opinion of the Engineer or Owner the removal of sheeting would endanger the Work built under this Contract or any adjoining improvements, such sheeting will be ordered to be left in place and the tops cut off as directed. Any timber directed to be left in place will not be paid for as supplemental price. No additional payment will be made for sheeting when directed to be left in place.
 - F. In quicksand or soft ground, drive sheeting to such depth below bottom of the trench to prevent upheaval, or as directed.
 - G. Fill and thoroughly compact all holes and voids left in the work by the removal of sheeting, shoring, or bracing.
 - H. It shall be the sole and exclusive responsibility of the Contractor to meet local and OSHA safety requirements in meeting the need and adequacy of sheeting, shoring, bracing, or other provisions to protect workers and equipment in a trench or other excavation.

3.5 EXCAVATION

A. General

1. Excavation includes the removal of all material from an area necessary for the construction of a pipeline, structure, basin, flume, or building. Provide adequate working space and clearances in excavations for the work to be performed therein.
2. Except where otherwise shown on the Drawings or specified herein, replace all material excavated below the bottom of concrete walls, footings, and foundations, at the Contractor's expense, with Class A concrete to the lines and grades shown on the Drawings.
3. Where quicksand, soft clay, spongy, swampy, or other materials unsuitable for subgrade or foundation purposes are encountered below the excavation limits, remove and dispose of such to the level of suitable material. Backfill areas so excavated with Class A concrete or with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
4. Place barriers at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Place lights along excavations from sunset each day to sunrise of the next day until the excavations are backfilled. Barricade all excavations in such a manner as to prevent persons from falling or walking into any excavation.

B. Excavation Methods

1. Use open-cut techniques for all excavation unless otherwise indicated on the Drawings or approved by the Engineer or Owner. In general, topsoil may be removed by machine methods. Excavation below topsoil may also be performed by machine but shall be supplemented by such hand dressing or leveling as may be required to conform to lines and grades as given by the Engineer or Owner. Use material so removed in backfill, making embankments, filling low areas, or as otherwise directed.

2. Use hand tool excavation where necessary to protect existing utilities and structures.
3. Carefully cut or grade all slopes to the grades as detailed on the Drawings, and/or required by the Engineer. Tamp or otherwise compact slopes to maintain the material in position.
4. It is the Contractor's sole and exclusive responsibility to have all excavation conform to local and OSHA safety requirements.

C. Rock Excavation

1. All excavation is considered unclassified. Include all cost of rock excavation (excavating, blasting, loading, hauling, crushing, backfilling, and/or disposing) in the lump sum or unit price bid amount for the associated work.
2. Uncover and strip all loose materials and/or rock encountered in the process of excavation for structures over the entire limits of excavation. Uncover rock encountered for removal in a trench section for a distance of not less than 50 feet.
3. Excavate rock and large boulders in trenches over the horizontal limits of excavation and to depths as follows:

Size of Pipe (inches)	Depth of Rock Excavation Below Bottom of Pipe (inches)
3 and smaller	4
4 to 6	6
8 to 18	8
18 to 30	10
32 and larger	12

4. Backfill the space below the bottom of the pipe to the proper grade with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill. Where pipe sewers are constructed on concrete cradles, excavate rock to the bottom of the cradle as shown on the Drawings.
5. Excavate rock under structures to lines and grades shown on the Drawings. Unless specified otherwise, where rock excavation has been carried below required grade, backfill to grade with bedding material.
6. Where rock foundation is obtained at grade for over 50 percent of the area of any one structure, excavate the portion of the foundation that is not rock below grade to reach a satisfactory foundation of rock. Backfill the portion below grade with bedding material.
7. Where rock foundation is obtained at grade for less than 50 percent of any one structure and satisfactory rock cannot be found over the remaining area by reasonable additional excavation, remove the rock for a depth of 12 inches below grade and backfill the space below grade to the proper grade with compacted layers of crushed rock conforming to the requirements specified herein for backfill.
8. Conduct drilling and blasting operations in accordance with the requirements of paragraph 3.6, below.
9. Complete rock excavation for all structures and adjacent trenches under this Contract and any other rock excavation before construction of any structure is started in the vicinity.

D. Borrow Excavation

1. When sufficient amount of suitable excavated material to complete the Work is not available on the project site; or wherever the backfill of excavated areas or the placement of embankments or other fills requires specified material not available at the site or material in excess of suitable material available from the authorized excavations, obtain such materials from other sources. This may require the opening of borrow pits at points not immediately accessible from the Work. In such cases make suitable arrangements with the property owner and pay all costs incident to the borrowed material including royalties, if any, for the use of the material. Before a borrow pit is opened, the quality and suitability of the material to be obtained from the borrow pit shall be approved by the Owner. No borrow excavation shall be made within the bed limits of any existing or projected public highway.
2. Clear, grub, and finish grade borrow pits in accordance with the requirements specified herein.

E. Structural Excavation

1. Structural excavation consists of the removal of all materials necessary for the construction of structures, including tanks, foundations, footings, wet wells, dry wells, box culverts, flumes, channels, buildings, and other miscellaneous structures.
2. Make the bottom of structural excavations true to the lines and grades shown on the Drawings. Do not undercut faces of excavations for extended footings. Except as provided herein for excavation of unsuitable material or rock, where the excavation is carried below the grade elevation shown on the Drawings, backfill the void thus made to the proper grade with Class A concrete at the Contractor's expense.

F. Trench Excavation

1. Excavate trenches to the lines and grades shown on the Drawings with the centerlines of the trenches located on the centerlines of the pipes.
2. Make the sides of all trenches vertical to a minimum of one foot above the top of the pipe. From the bottom of the trench to twelve inches (12-inch) above the pipe, the maximum width shall be as indicated on the Drawings. This distance will be measured at an elevation in trench which is 12 inches above the top of the pipe when laid to grade. Excavation of pipe trenches with side sloping to the bottom will not be permitted.
3. Wherever the prescribed maximum trench width is exceeded, use the next higher class (load factor) of embedment or encasement for the full trench width as actually cut at no additional cost to the Owner.
4. Excavate the trenches to the required depth allowing for the placement of pipe bedding to the thickness shown on the Drawings.
5. Should the bottom of the trench become an unstable foundation for the pipe through the failure of the Contractor to adequately perform, remove the unstable material and fill the trench to the proper subgrade with crushed rock. No extra compensation will be allowed for this material or work. Should the trench be inadvertently excavated to a greater depth than necessary, provide crushed rock fill to the proper subgrade at no additional cost to the Owner.
6. Should the undisturbed material encountered at the grade depth constitute, in the opinion of the Engineer, an unstable foundation for the pipe, remove such unstable material and fill the trench to the proper subgrade with crushed rock.

7. Contractor shall not have more than five hundred (500 feet) of trench open at any one time. New trenching will not be permitted to be excavated if there are previously excavated trenches that require backfill or surface area restoration. Cleanup and grassing shall follow a maximum of 500 feet of pipe installation.
8. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water from running into the excavation.

3.6 BLASTING

A. Requirements

1. Blasting for removing rock for excavation shall be properly permitted.
2. Contractor shall use all possible precautions against accidents or damages due to use or storage of explosives, and Contractor assumes all responsibility/liability associated with blasting activities.
3. ONLY LICENSED EMPLOYEES OR SUBCONTRACTORS WILL BE ALLOWED TO CONDUCT BLASTING ACTIVITIES – PROOF OF SUCH PROPER LICENSING MUST BE PROVIDED TO Owner PRIOR TO ENGAGING IN ANY BLASTING ACTIVITIES.
4. Furnish all labor, equipment and materials required to drill, blast, loosen, excavate, and dispose material to complete the work shown on the Drawings and specified herein.
5. The work includes, but is not be limited to:
 - a. Blast round design.
 - b. Planning and execution of appropriate site-specific safety measures to be employed during all blasting operations, and the safe handling and storage of high explosives and blasting agents.
 - c. Drilling blast holes, loading blast holes with explosives, and wiring and safe detonation of blast rounds.
 - d. Removal from the site of all excess excavated soil, debris, and rock as indicated in the contract Documents, or as directed by the Engineer, and disposal of excess materials at a permitted disposal site.
 - e. Dewatering and maintenance of groundwater and surface water in all excavations.
 - f. Performance of all surveys necessary to establish and verify the lines and grades and to determine the amount of material removed.
 - g. Implementation of monitoring program to monitor condition of existing structures and utilities in vicinity of proposed blasting operations to insure existing features remain undamaged by blasting procedures.
6. Make all excavations in conformance with the lines, grades, and cross sections on the Drawings or established by the Engineer. Where blasting is required, blasting should ensure removal of six (6 inch) of rock below proposed grade line. All overblast shall be removed and the resulting overexcavation backfilled and compacted with #57 gradation stone coarse aggregate.
7. Conduct all blasting operations, including transporting and storing of explosives in compliance with the Georgia State Fire Commissioner's Rules and Regulations for Explosives and Blasting Agents, latest edition, and all applicable local codes.

B. Submittals

1. Submit the following in accordance with the procedures and requirements set forth in Section 01 33 00 Submittal Procedures, at least thirty (30) working days prior to beginning any blasting operations:
 - a. Names, addresses, telephone numbers, and qualifications of the blasting subcontractor(s) and explosives supplier(s) that will be used, including the designated Blaster-In-Charge.
 - b. Copies of Training Certificates for the designated Blaster-In-Charge, blasting foreman and any other key personnel that will be responsible for the work, showing that they have received specialized training in the proper handling of explosives.
 - c. A Blasting Plan, indicating the methods, materials, and equipment to be used. The Blasting Plan should indicate the types of explosives to be used, drilling patterns, and a general layout and schedule for executing the work in accordance with state regulations.
 - d. A ground vibration and air blast monitoring plan, indicating structures that will be monitored, monitoring equipment that will be used, and personnel that will perform the monitoring.
2. At least 24 hours before each blast round, submit a detailed blast round design plan to the Engineer's or Owner's on-site representative. The blasting plan submitted is for quality control and record keeping purposes. Review by the Engineer does not relieve the Contractor of his responsibilities as provided herein. Include the following in the blast round design submittals:
 - a. Location (state, grid coordinates) and limits of the shot.
 - b. Number, diameter, and depth of blast holes to be detonated in the round, and a plan showing the drill hole pattern, spacing and distance to the free face.
 - c. Depth of overburden.
 - d. Total weight of explosives in the round and the types of explosives to be used.
 - e. Loading diagram showing the location of explosives, primers, and initiators; and location, depth, and type of stemming to be used in each hole.
 - f. Initiation sequence, including delay timer and delay system, total weight of explosive to be detonated on each delay, and a list of the timing of the delays.
 - g. Manufacturer's data sheet for all explosives, primers, and initiators to be used.
 - h. Planned seismic monitoring positions, distances from the blast round, and seismograph types to be used to monitor vibrations and air blast overpressures.
 - i. Type and amount of blasting mats and/or depth of soil cover to be used over the top surface of the shot.
 - j. Any other information required by applicable state and federal regulations.
3. Within 24 hours after each blast round, submit a blasting report to the Engineer. Include the following in the blasting report:
 - a. Date and time of shot.
 - b. Foreman's name.
 - c. Number and depth of holes detonated.
 - d. Weather conditions at the time of detonation.
 - e. Type of explosives and detonators used.

- f. Peak particle velocity of ground motion and primary frequency for all ground vibration monitoring stations.
- g. Peak air blast overpressure measured.
- h. Distance from the blast round to each monitoring station for vibrations and air blast.
- i. Amount of explosive used in each hole, and maximum weight of explosive detonated on any single delay in the blast round.

C. Pre-Blast Survey

1. Contractor shall have an approved vibration consultant conduct the pre-blast survey on the residences and facilities adjacent to the proposed rock blasting in accordance with the submitted survey and monitoring plan. The survey shall include, but not be limited to the following:
 - a. A site plan or drawing of the structure to be examined showing the structure in relationship to the proposed rock blasting area and a full description of the structure including type of materials and construction.
 - b. Examination of the structure (interior and exterior surfaces) by experienced and qualified personnel, noting any visible structural and aesthetic flaws in or on the structure. Note existing cracks and flaws, with significant cracks measured, and all cracks and flaws photographed.
 - c. Upon completion of the examination, ask the structure's owner to review the report, note any corrections or omissions, and sign a statement that to the best of his knowledge, the examination report reflects the conditions of the structure prior to any rock blasting. If the structure's owner refuses to sign said report, it should be noted in the report by the examiner.
 - d. Nothing contained herein shall relieve the Contractor of responsibility for claims arising from his construction operations. Failure to inspect any structure, whether or not required by these Contract Documents, or inadequacy of the inspections shall not relieve the Contractor of his responsibility. The Contractor shall indemnify the Brunswick-Glynn Joint Water & Sewer Commission from such claim.
 - e. In the event that any property owner denies access for the survey of structures and facilities, notify such property owner, by certified mail, stating that this is final notification. Submit to the Engineer and Owner copies of all correspondence between the Contractor and the property owner(s). The Engineer, upon review of the submitted correspondence may waive requirements set forth above. However, the Contractor is fully responsible for claims and damage arising from his construction operations regardless of property location.
 - f. Submit two (2) sets of copies of the examination reports to the Engineer and Owner for their records.

D. Use of Explosives

1. When the use of explosives is necessary for the prosecution of the work, exercise the utmost care not to endanger life or property. Be responsible for any and all damage or injury to persons or property resulting from the use of explosives.
2. Store all explosives in a secure manner, in compliance with all laws, and clearly mark all such storage places "DANGEROUS EXPLOSIVES".
3. Notify any public utility company having facilities in close proximity to the site of the work of the intention to use explosives. Provide this notice sufficiently in advance to

enable the utility companies to take whatever steps they may consider necessary to protect their property from injury. Also give the Engineer, all occupants of adjacent property, and all other Contractors working in or near the Project, notice of the intention to use explosives.

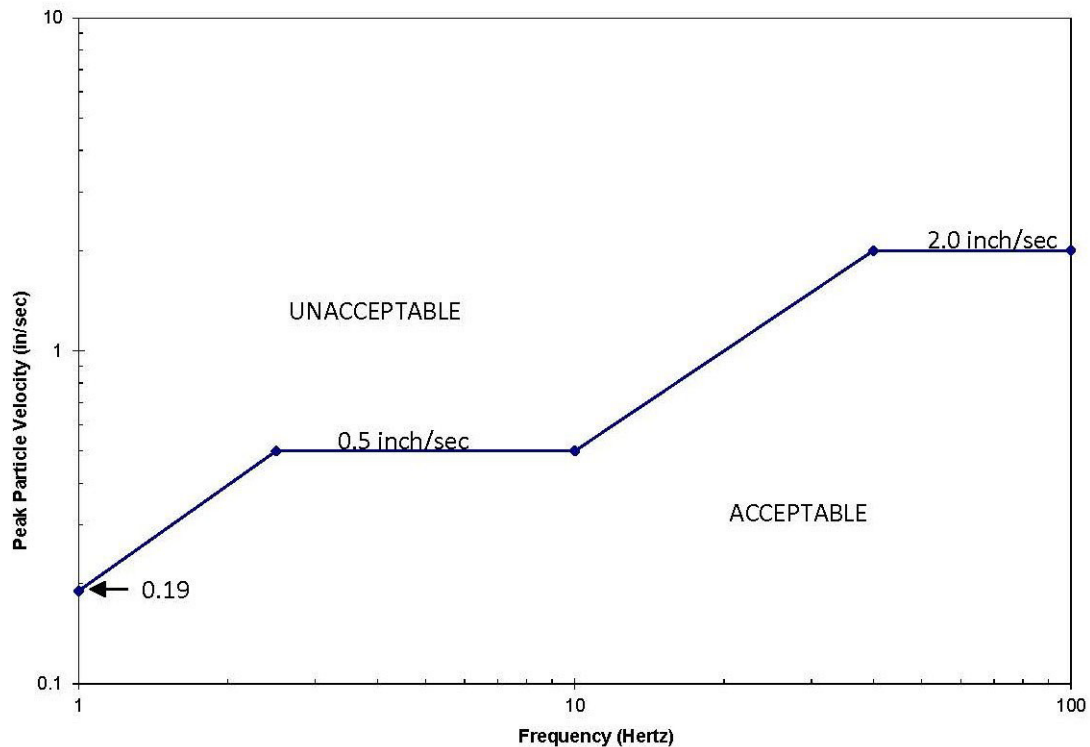
4. Only non-electric type initiators maybe used.

E. Blasting Operations

1. Provide explosives of such quantity and power and use in such locations as will neither open seams nor otherwise disturb the material outside the prescribed limits of excavation. As the excavation approaches its final limits, reduce the depth of holes for blasting and the amount of explosives used for each hole so that the underlying or adjacent rock will not be disturbed or shattered.
2. Do not perform blasting within 100 feet of newly placed concrete that has cured less than 7 days. Do not perform blasting within 50 feet of any existing structure or any new structure in progress.

F. Blast Monitoring

1. Exercise the utmost care not to damage property on-site and off-site. Notify each adjoining property owner within 5,000 feet of the site of the anticipated ground vibrations and noise which will occur due to the blasting operations. Provide this notice 30 days in advance to enable the adjacent property owners to take whatever precautions they may consider necessary. Limit operations to minimize any disturbance to the adjacent property owners. Notify motorists on adjacent roadways in accordance with state regulations. Take responsibility for any damage to any structure or utility line, pipes, etc., on-site, and off-site as a result of his operations.
2. For each blast round, monitor and record noise and air blast overpressures at the site perimeter nearest the blast location and at the on-site or off-site structure located nearest to the round. Peak air blast overpressure shall not exceed 0.018 psi, measured at the site perimeter.
3. Sufficiently cover the site of every blast round with blasting mats or other devices to prevent any flying debris. The number and type of blasting mats must be satisfactory to the Engineer. The Contractor will be fully responsible for any damage caused by flying debris, both to on-site and off-site properties.
4. Whenever blasting is to be performed within 2,500 feet of any structure, measure the peak particle velocities of ground vibration resulting from each blast at the structure. Monitor vibrations utilizing a seismograph capable of providing a record of particle velocity and frequency along three mutually perpendicular axes utilizing internal calibration. Measured peak particle velocity of ground motion at the monitored structure shall not exceed the values shown in the following graph:



G. Notification

1. Give twenty-four (24) hour notice to Engineer and adjacent residences and/or businesses prior to each blast.

H. Complaints

1. Submit notice of blasting complaints to Engineer in writing within twenty-four (24) hours of receipt thereof. Identify the origin of complaint in the notice and provide a brief description of alleged damages or other circumstances upon which the complaint is predicated. Assign a number to each complaint consecutively in the order of receipt. Assign each complaint a separate number and show in each letter complaint all previous complaint numbers registered by the same complainant. In addition, make a summary report each month to Engineer. Indicate date, time and name of person investigating the complaint and amount of damages (or an estimate thereof), if any, in the summary report.

I. Post Blast Survey

1. Contractor shall have the same vibration consultant who performed the pre-blast survey conduct the post-blast survey. The consultant shall examine all structures from which a complaint has originated after the blast. The survey shall include, but not be limited to the following:
 - a. A full description of the alleged damage caused by the blast. Where appropriate, provide a sketch to more fully describe the location and type of damage. Measure cracks and compare them to any original measurements which may have been taken in the Pre-Blast Survey.
 - b. Take colored photographs of any alleged damage.

- c. Submit two (2) copies of the Post Blast Survey report to the Engineer. The report shall include the consultant's assessment of the alleged damage and an opinion as to its likely cause.

3.7 UNAUTHORIZED EXCAVATIONS

- A. All excavations carried outside of the lines and grades given or specified, together with the disposal of such material and all excavations, and other work resulting from slides, cave-ins, swellings, or upheavals shall be at the Contractor's own cost and expense. All spaces beneath foundations resulting from unauthorized excavations, slides, or cave-ins shall be refilled at the Contractor's expense, with bedding materials or concrete, as directed. This is to include all landscaping outside of the lines and grades given or specified.

3.8 BEDDING

- A. All pipe bedding requirements, as specified, are to be considered minimum requirements, and as such, do not relieve Contractor of the responsibility to provide additional bedding necessary for proper support of the pipeline and appurtenances, or as directed by the Engineer or Owner.
- B. Bell holes shall be provided in all classes of bedding, so as to relieve pipe bells of all loads, but small enough to ensure support is provided throughout length of the pipe.
- C. Trench shall be excavated to allow the placing of bedding material for the full trench width and spread to form a uniform support (foundation cushion) for the pipe and appurtenances, and then compacted as specified on the Drawings so that the pipe is true to line and grade. Remaining bedding material shall be carefully placed such that bedding material fills and supports the haunch area and encases the pipe to the limits specified and compacted according to the bedding class specified, as indicated on the Drawings, or directed by the Engineer or Owner.
- D. Unless otherwise specified, at a minimum, Type IV Bedding shall be used for pressurized mains of ductile iron pipe material (sanitary sewer force main and water main).
- E. Unless otherwise specified, at a minimum, Type V Bedding shall be used for gravity sanitary sewer of ductile iron pipe material.
- F. Unless otherwise specified, at a minimum, gravity sanitary sewer of polyvinylchloride (PVC) pipe material shall be laid atop a minimum of six inches of No. 57 stone. No. 57 stone shall be extended to the top of pipe.
- G. All pipe installed within rock excavation shall be laid upon a minimum of six inches (6-inch) of #57 gradation stone coarse aggregate.
- H. Groundwater Flow Dams will be required under certain conditions. If there is a large volume of groundwater, which will follow the crushed stone bedding downhill due to the elevations involved, and builds adequate pressure to washout the stone bedding, Flow Dams will be required. Flow Dams shall consist of clay bedding three feet (3 feet) long and spaced every one hundred (100 feet) along the pipeline route.

3.9 BACKFILLING

A. General

1. Unless otherwise specified herein, compact earth backfill to specified maximum dry density as determined by Standard Proctor, ASTM D-698. Compact or consolidate crushed stone to specified maximum dry density as determined by Modified Proctor, ASTM D-1557; or as directed by Engineer or Owner Testing Materials Representative.
2. Prior to placement, add sufficient water to secure optimum moisture content to material that is too dry for adequate compaction. Do not place material having excessive water content at any time.
3. Unless otherwise specified herein, place backfill material required to be compacted in horizontal layers not to exceed six (6) inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling. Accomplish compaction by power driven tools and machinery wherever possible. Accomplish compaction and consolidation of sand and crushed rock backfill using vibrating equipment.

B. Backfilling Structures

1. Backfilling around structures consists of common earth backfill and shall be placed in 6-inch lifts and compacted to a minimum of 95 percent of the maximum density (determined by Standard Proctor D698) for the full depth of the excavation from the bottom to the finished grade. Do not place backfill against concrete structures until the concrete has reached its specified 28-day compressive strength. Where practical, accomplish compaction of structural backfill by power-driven compaction equipment.
2. Where crushed rock mats under slabs and foundations are called for on the Drawings, excavate below grade to the depth of the crushed rock mat as shown on the Drawings and install a compacted crushed rock bed. Finish the bed to a true line or plane and even with the subgrade of the concrete foundations, piers, footings, or slabs. Before placing any crushed rock, remove all loose earth or debris. Extend this crushed rock mat 12 inches beyond all slabs and foundations or to edges of sheet piling.
3. Construct crushed rock mats, 12 inches or less in thickness, of compacted layers of crushed rock conforming to Section 815.01 Class A, Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges.
4. Construct the top 12 inches of crushed rock mats of thickness greater than 12 inches of compacted layers of crushed rock as specified above. Construct that portion below the top 12 inches of compacted layers of crushed rock as specified, with a modified gradation of 6 inches to dust as received from the crusher.
5. Compact fill under slab-on-grade to 98 percent Standard Proctor Density ASTM D698, at moisture content between 2 percent below and 3 percent above the optimum moisture content.
6. Compact granular structural fill under foundation elements, i.e., footings and base slabs for tanks and basins to 100 percent Standard Proctor Density ASTM D698, at moisture content between 2 percent below to 3 percent above the optimum moisture content.
7. Unless otherwise shown on the Drawings, do not use earth backfill to support footings, foundations, and structures.

C. Backfilling Trenches

1. Except as otherwise specified or directed, all forms, bracing, and lumber shall be removed before backfilling.
2. Backfill in paved areas shall include Initial, Final and Sub-base backfill; backfill in unpaved areas shall include Initial and Final backfill and final grading of ground surface; including areas damaged by the Contractor.
3. Trench bottoms of earth must be shaped or molded and compacted to the contour of the outside of the pipe, using bedding materials as specified, as indicated on the Drawings, to give full support of the pipe, such that the pipe is firmly supported in the excavation throughout its entire length, and in such a manner as to prevent any subsequent settlement of the pipe. Rocks larger than two inches (2-inch) diameter will not be permitted in the trench bottom or in the Initial backfill, up to a depth of twelve inches (12-inch) above the top of the pipe. Bottom of excavation, which is of loose granular soil, shall be compacted prior to placing bedding or pipe.
4. Initial backfill in trenches where pipe has been laid shall be placed in lifts not exceeding six inches (6-inch) in thickness, and carefully and thoroughly consolidated by compacting simultaneously on both sides of the pipe to a height of twelve inches (12-inch) above the pipe. Initial backfill material shall be free of rocks larger than two inches (2-inch) in diameter, clods, organic matter, rubbish, or other unsuitable material. Initial backfill must be properly placed before any fill is deposited in large quantities from a machine bucket or other vehicle. During Initial backfill, dumping from a bucket must not be allowed to fall upon a pipe from a height of more than one foot (1 foot), and in all cases the bucket must be lowered so that the shock of the falling earth will not injure the pipe or structure. Only after the Initial backfill has been placed and compacted to a point of twelve inches (12-inch) above the top of the pipe, may Work proceed in placing Final backfill. All precautions must be taken to avoid future settlement in these areas. Compaction shall be performed by approved mechanical compaction devices.
5. Final backfill under paved areas shall be placed in lifts not to exceed eight inches (8-inch) and shall be compacted to a density of not less than 95 percent of maximum dry density, as determined by Standard Proctor (ASTM D698). Final backfill in unpaved areas within road right-of-way shall be placed in lifts not to exceed eight inches (8-inch) and shall be compacted to a density of not less than 90 percent of maximum dry density, as determined by Standard Proctor (ASTM D698). Final backfills in unpaved areas outside of road right-of-way shall be placed in lifts not to exceed eight inches (8-inch) and shall be compacted to a density of not less than 85 percent of maximum dry density, as determined by Standard Proctor (ASTM D698). Final backfill material shall be free of clods, organic matter, rubbish, or other unsuitable material. Rocks larger than four inches (4-inch) in diameter must be placed to the sides of the trench. Rocks larger than twelve inches (12-inch) are not allowed.
6. Sub-base backfill is comprised of the top twelve inches (12-inch) of Final backfill in paved areas and shall be free of rocks larger than four inches (4-inch) in diameter, clods, organic matter, rubbish, or other unsuitable material. Sub-base backfill shall be placed in lifts not to exceed six inches (6-inch) and shall be compacted to 98 percent of maximum dry density, as determined by Standard Proctor (ASTM D698).
7. Backfilling shall not be performed in freezing weather (below 32-degree F) except by permission of Owner and shall not be done with frozen material or upon frozen material.

8. All Final backfilling in unpaved areas shall be left free of rock on the ground surface, with smooth, even surfaces, properly graded and shall be maintained in this condition until vegetation is established. Where directed by Owner, Final backfill shall be mounded slightly above the adjacent ground to account for settlement. In case of settlement after backfill, Contractor shall correct the cause of the settlement and supply sufficient material satisfactory to Owner to make up for deficiency. Contractor must provide Owner with any independent material testing reports performed on behalf of the Contractor.
9. Fill trenches under concrete slabs and footings of structures with dry sand or crushed stone and tamp in 6-inch layers. Encase piping under concrete slabs and footings in concrete (6 inches minimum).

3.10 FILLS AND EMBANKMENTS

- A. Fills and embankments consist of all earth fills except backfills in trenches or around structures. Unless special material is specified or shown on the Drawings, material for fills and embankments consist of excavated material from structures or of a mixture of such excavated materials and materials borrowed from other sources by the Contractor. Provide all material used for fills and embankments free from wood, vegetable matter, debris, soft or spongy earth or clay, large rock, or other objectionable material. Do not allow rock over 2 inches in diameter to be used in conjunction with backfill material.
- B. Where the crown of a pipe extends above the surface of the ground or provides less than three feet (3 feet) of cover over the pipe, the pipe shall be covered and protected by an embankment. Unless otherwise specified, indicated on the Drawings, or directed by the Engineer or Owner, embankment shall be at least three feet (3 feet) deep over the top of the pipe, at least four feet (4 feet) wide at the top, with side slopes of not less than two horizontals to one vertical (2H:1V) extending to the surface of the ground. Provision shall be made for surface drainage.
- C. Place materials in the fill or embankment in successive layers 6 inches or less in thickness before compaction, each layer being approximately horizontal and extending to the full limit of the required cross section. Compact the fill at optimum water content over the entire surface to not less than 95 percent of the maximum density as determined by Standard Proctor (ASTM D698). Repeat the process for each layer of material until the fill or embankment conforms to the plan lines, grades, and cross sections.
- D. Clear the area over which the fill or embankment is to be constructed of all vegetation, debris, and other objectionable material and, if the ground is in a loose, un-compacted condition, compact it to a minimum 95 percent of maximum density determined as specified herein.
- E. Do not place material beyond the sloping lines of embankment.
- F. Place material for embankments or roadway fills in 6-inch maximum lifts and compact by rolling with power rollers weighing not less than 10 tons, with sheep-foot rollers, with vibrating rollers, or with pneumatic tire rollers, as required to accomplish the work. While and as each layer is deposited, apply water in sufficient amount to ensure optimum moisture to secure the compaction specified.

- G. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of rollers.
- H. Wherever a trench passes through a fill or embankment, place and compact the fill or embankment material to an elevation 12 inches above the top of the pipe before the trench is excavated.

3.11 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. Use all materials removed by excavation, which are suitable for the purpose, to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. Consider all materials not used for such purposes as waste materials and dispose thereof in a lawful manner and at a location where such materials can be lawfully disposed.
- B. Spread waste materials in uniform layers and neatly leveled and shaped. Provide spoil banks with sufficient and adequate openings to permit surface drainage of adjacent lands.
- C. Remove unsuitable materials, consisting of wood, shot rock, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material from the work site and dispose of in a lawful manner.
- D. Do not dump unsuitable or waste material on private property unless written permission is furnished by the owner of the property and unless a dumping permit is issued from the local jurisdiction.
- E. Immediately remove and cleanup any material, which may spill or drip from vehicles while being transported on public streets, drives, or other paved surfaces, to the satisfaction of the Engineer, Owner, or the proper officials of the municipality in which the hauling or work is being done.
- F. Leave the surface of all graded and spoil areas in a smooth and level or evenly sloped condition, free from stones, rubbish, or other debris.
- G. Leave disturbed areas in a neat and finished appearance and either temporarily stabilized with mulch only or temporary grassing and mulch, or permanently stabilized with grassing and mulch. Meet the requirements in the section titled Erosion and Sedimentation Controls.

3.12 SPOIL REMOVAL

- A. The term Spoil Removal as used herein shall mean handling, hauling, and properly disposing of all surplus excavated earth material from the site as defined in the Contract Drawings from the bottom of the bedding to finished grade as directed by the Owner. The cost of removing, handling, and disposal of Spoil Removal shall be included in the lump sum cost for the tank construction.

3.13 STORAGE OF MATERIALS

- A. All salvageable materials, which may be removed from the site, together with all materials taken from the site, shall be stored in an approved, suitable place or as directed by Owner. The Contractor shall be responsible for any loss of or damage to salvageable materials through careless removal, neglectful or wasteful storage disposal, or use of such material.
- B. In the storing of excavated material, which is to be used as a backfill, the Contractor shall exercise care so as to avoid inconveniencing the public. If, in the opinion of the Owner, it is necessary to remove this excavated material from the streets or lots, the Contractor will be required to do so at no cost to the Owner.
- C. Stored materials shall be left in a neat, drainable condition and, if left for more than seven (7) days or in an anticipated rainfall event, the areas shall be temporarily stabilized with mulch only or with temporary grassing and mulch and must meet the requirements in the section titled Erosion and Sedimentation Controls.

3.14 FINAL GRADING

- A. After other earthwork operations have been completed, grade the site of all structures, roads, and embankments within the limits and to the elevations shown on the Drawings. Conduct grading operations so as not to remove or loosen materials beyond the required limits. Leave the finished surfaces in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment, he will not be required to use hand labor methods. Neatly trim and finish slopes and ditches to slopes shown on the Drawings.
- B. Unless otherwise specified or shown on the Drawings, grade and dress all finished ground surfaces to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions.

3.15 TOP SOIL

- A. Prepare all areas to be sprigged or planted with grass as shown on the plans by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. Bring the area to a neat, finished grade by the addition of 4 inches of approved top soil.
- B. Top soil removed from the construction area may be stockpiled and reused or top soil may be obtained from approved borrow areas. If obtained from borrow areas, make suitable arrangements with the property owner and pay all costs incident to the borrowed material including royalties.

3.16 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final acceptance of the work by the Owner.
- B. Make all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

3.17 ACCESS BY OWNER'S MATERIAL TESTING FIRM

- A. Contractor shall allow and accommodate both scheduled and unscheduled sampling of excavation materials and backfill which include, but are not limited to excavating and setting aside directed materials for sampling, providing description, properties, moisture content, dry density, sieve analysis, Atterberg limits, compaction testing, permeability, etc.
- B. All cost associated with initial material testing will be paid by Contractor. The cost of retesting due to the failure of Contractor to meet specifications of initial required material testing requirements of the Contract Documents shall be the responsibility of the Contractor.
- C. For scheduled testing, the Contractor shall give a minimum of twenty-four (24) hour notice when scheduling testing and/or evaluations.
- D. For unscheduled testing, Contractor shall cooperate fully with providing access to, and/or setting aside as directed, construction materials for obtaining samples for testing and/or evaluation.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.1 SUMMARY

- A. Scope: This Section specifies the design, installation, operation, and maintenance of the systems necessary to dewater structure and trench excavations at no additional cost to the Owner.
 - 1. During excavation the Contractor may encounter perched water. The Contractor shall control groundwater seepage and surface runoff so as to prevent entry or collection of water in excavations.
 - 2. The Contractor shall divert stormwater flow around the work area for the duration required to perform excavation, stockpiling, and backfill activities. Erosion control and water pollution control requirements are shown on Contract Drawings.
 - 3. All sediment laden groundwater produced from excavations and surface runoff entering excavations shall be collected and conveyed to an approved onsite location and dissipated (i.e., no offsite discharge is allowed).
- B. Definitions: Terminology used in this Section conforms to the following definitions:
 - 1. Control of Water: General term referring to the management of groundwater and surface water inflow into excavations.
 - 2. Control of Water System: General term referring the Dewatering Systems.
 - 3. Dewatering: General term referring to the process of removing accumulated water, including precipitation, water separated from excavated soils and seepage from the open excavation or from excavated soils.
 - 4. Dewatering System: System to collect and remove said accumulated water from the open excavation or from excavated soils.
 - 5. Watertight: Level of tightness required for installed barriers to minimize the groundwater seepage and inflow of water into excavations to accommodate design criteria.
 - 6. Groundwater Seepage: Groundwater entering an excavation as inflow or seepage from exposed soils in the excavation and installed watertight systems.
 - 7. Perched Water: A layer of saturated soil that results when an underlying impermeable layer restricts the downward movement of water. This water table is usually above the regional water table.

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
 - 2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if

there are no replacement documents, the last version of the document before it was discontinued.

1.3 SUBMITTALS

- A. Procedures: Section 01 33 00.
- B. Informational submittal items for this section:
 - 1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.
 - 2. Dewatering Plan: Dewatering Plan outlining the method and installation of the dewatering system, including details. The Plan shall include the following:
 - a. Indicate number and type of equipment and pipelines and other means of conveyance, including capacities.
 - b. Dewatering pit and sump locations and water discharge locations.
 - c. Dewatering well locations and water discharge locations.
 - d. Groundwater monitoring systems where necessary.
 - e. Filter systems and locations as necessary, and such other information to verify acceptable control and performance.
 - f. The Plan shall include the following excavation dewatering elements:
 - 1) Details of methods to maintain the excavations in a dewatered and hydrostatically relieved condition.
 - 2) Systems for control of groundwater inflow into excavations using watertight barriers, grouted soil masses, or other means.
 - 3) Method for the measurement of inflow into excavations.
 - g. The Plan shall include the following surface water flow elements:
 - 1) Method for prevention and removal of surface water flow entering the excavation.
 - 3. Contact Information and Reporting:
 - a. The Contractor shall submit contact information for a designated emergency contact. The contact shall be a responsible individual available at all times.
 - b. The Contractor shall resubmit components of the drawings and design data if the systems or any part thereof is significantly modified during installation or operation.
 - c. Before dewatering commences, the Contractor shall obtain the acceptance of the Owner for the method, installation, and details of the dewatering system proposed for use.
- C. Review by the Owner of the submitted Dewatering Plan shall not in any way relieve the Contractor from responsibility for errors therein or from the entire responsibility for a complete and adequate dewatering system. The Contractor shall bear sole responsibility for proper design, installation, operation, maintenance, and any failure of any component of the groundwater control system for the duration of this Contract.

1.4 PERFORMANCE REQUIREMENTS

- A. Discharges of groundwater and surface water collected from excavations shall meet the discharge requirements of the State of Georgia, including discharges to infiltration facilities.
- B. Comply with State of Georgia standards for the drilling, installation, construction, and abandonment of all dewatering wells, well points, monitoring wells.

PART 2 NOT USED

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish, install, operate, maintain, and remove all necessary equipment to keep excavations free from water during construction as needed to perform the excavations and to divert water around work areas. The withdrawal, removal, or disposal of the water shall not cause injury to public or private property or nuisance to the public.
- B. Sufficient pumping and power equipment in good working condition shall be available at all times for all emergencies, including power outage, and competent workmen shall be available at all times for the operation of the dewatering and bypass system.
- C. Systems shall not be shut down between shifts, on holidays, or weekends, or during work stoppages.
- D. The Contractor has the option to install groundwater monitoring wells prior to excavating in order to verify adequacy of Contractor-designed dewatering system. However, if the system as designed is incapable of maintaining a dewatered excavation, the Contractor shall modify the system as required at no additional cost to the Owner. Any wells used for monitoring or dewatering shall be developed, drilled, and abandoned meeting the requirements of federal, state, and local codes.

3.2 DEWATERING SYSTEM OPERATION

- A. The dewatering system shall be installed and operated so that the groundwater level outside the excavation or fill areas is not drawn down to the extent that would damage or endanger adjacent slopes, structure, underground installation, sidewalk, pavement, other improvement, or property.
- B. Configuration and sizing of the dewatering system shall take into account runoff from areas adjacent to the Work where existing drainage patterns are interrupted.
- C. During any backfill, filling, and compaction activities, control surface runoff so as to prevent entry or collection of water in excavations and fills. The static water level within excavations shall be drawn down a minimum of 1 foot below the bottom of the excavation so as to maintain the undisturbed state of the foundation soils and allow acceptable placement of any backfill to the required density.

- D. Discharge of water from the dewatering of the excavations shall be as shown on Contract Drawings. The Contractor may consider use of the stormwater pipeline to the existing on-site presettling pond and infiltration basin as a component of the dewatering system with the following provisions:
 - 1. The Contractor is responsible for verifying hydraulic requirements and capacity for coordination with the dewatering system.
 - 2. Identification and provision of any temporary facilities needed to connect to the pipeline are the Contractor's responsibility.
 - 3. Pipelines shall be cleaned and inspected, and the existing presettling pond shall be restored after dewatering system use.
- E. Immediate steps shall be taken including but not limited to the modification of excavation and ground support procedures and ground permeability modifications, to reduce the inflow of water entering an excavation, where the volume or inflow rate is at risk of causing the following:
 - 1. Drawdown of the groundwater level to an unacceptable level for the area outside the excavation.
 - 2. Damage or has the potential of causing loss or damage to adjacent property or structures.
 - 3. Adversely affects the performance of the work.
- F. Excavations shall be kept free of water to the extent required to perform the Work during excavation. Excavations shall be kept free of water for backfill, slope construction, and compaction.
- G. Control surface runoff so as to prevent entry or collection of water in excavations or in other isolated areas of the site.
- H. Discharge Points:
 - 1. All water discharged shall be as shown on Contract Drawings.
 - 2. Dewater and dispose of the water so as not to cause injury to public, private, or other property, or to cause a nuisance or a hazard to the public.

3.3 ELECTRICAL SUPPLY FOR DEWATERING SYSTEM

- A. Supply two separate electrical services or sources to be used for dewatering, stormwater bypass, and construction stormwater collection and conveyance that are separate from each other and all other Contractor electrical requirements.

3.4 DEWATERING SYSTEM PROTECTION

- A. Take all reasonable precautions necessary to ensure continuous operation of the system.
- B. Mark and signpost all pump and pipeline locations.
- C. Standby pumps are to be fueled and on-line, isolated from the primary system by a valve at all times.
- D. Test daily all standby pumps and generators to ensure their immediate availability.

- E. Wherever vacuum headers or discharge lines are to be crossed for access and egress, use physical bridging devices such as a ramp to protect and separate the system from vehicular traffic.
 - 1. Bridges shall be capable of supporting the heaviest equipment on site and shall provide at least 1 foot of clearance between the dewatering system element and the underside of the barrier.
 - 2. Clearly identify with brightly colored or flagged 8-foot-high poles on each side of the access point for all vehicular access points to be used across the dewatering system.
 - 3. All pipelines with vehicular crossing bridges, such as ramps, shall be equipped with valves on both sides of the ramp.

3.5 DAMAGES

- A. Repair any damage to work in place that may result from inadequate or improper dewatering system installation, maintenance, and operation of the system, and any mechanical or electrical failure of the system. Work in place shall include but is not limited to:
 - 1. Structures, pipelines, and utilities.
 - 2. Other contractors' equipment.
 - 3. The excavation including damage to the bottom due to heave and removal of material and pumping out of the excavated area.
- B. Immediately support any footings, slopes, foundations, basement or walls, concrete driveways, pipelines, utilities, or other structures that become unstable and vulnerable to settlement due to removal or disturbance of groundwater. Support shall include but not be limited to shoring, sheeting, bracing, grouting, underpinning, driving piles, excavation, backfilling, placing new structural concrete beneath or adjacent to the unstable structure, or other means necessary to rectify the particular problem involved.
- C. Contractor is responsible for all loss or damage arising from removal or disturbance of groundwater including, but not limited to, subsidence damage or the loss of structural support that may occur in the prosecution of the Work.

3.6 SOIL AND GROUNDWATER DATA

- A. Soil and groundwater data are provided in the geotechnical report as referenced in the attachments.
- B. Use of available information in no way relieves the Contractor from its responsibility for the operation of a properly functioning dewatering system.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.1 SCOPE

- A. Related Sections: The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility at no additional cost to the Owner to do all the Work in accordance with the Contract Documents.
 - 1. Excavation and Fill 31 23 00.
 - 2. Grassing 32 92 00.

1.2 REFERENCES

- A. Drawings and general provisions of the Contract, including general and supplementary conditions and Division 1 Specification Sections, apply to this section.
- B. Contractor shall be familiar with the following referenced documents and keep them at the construction site at all times. These documents must be complied with as applicable.
 - 1. NPDES General Permit No. GAR100001, No. GAR100002, or No. GAR100003 (whichever applies) State of Georgia Department of Natural Resources Environmental Protection Division Authorization To Discharge Under The National Pollutant Discharge Elimination System Storm Water Discharges Associated With Construction Activity For Infrastructure Construction Projects (the NPDES permit), latest effective permit.
 - 2. Manual for Erosion and Sediment Control in Georgia (the "Green Book"), latest edition.
 - 3. State of Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges, (GDOT specifications), latest edition.
 - 4. National Stone Association, Aggregate Classification (NSA Classification).
 - 5. The Owner's, or local issuing authority Soil Erosion and Sediment Control Ordinance, latest edition.
 - 6. Stormwater Pollution Prevention Plan (SWP3) if included in the Contract Documents.
 - 7. Approved and permitted Erosion, Sedimentation, and Pollution Control Plan (ES&PC Plan) utilizing Best Management Practices (BMP), as required by Georgia Erosion and Sedimentation Act and NPDES General Permit.
 - 8. Comprehensive Monitoring Program (the CMP) as required by the NPDES General Permit.

1.3 DEFINITIONS

- A. Designer: For the purpose of this item, the term "Designer" means the person who has designed and stamped the Erosion Sedimentation and Pollution Control Plan, as used in language of permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references. This person has successfully obtained Georgia professional registration, met certain education requirements, and been certified as Level II Certified

Design Professional, as prescribed by the Georgia Soil and Water Conservation Commission in consultation with the Georgia EPD and the Stakeholder Advisory Board.

- B. Contractor: For the purposes of this item, the term "Contractor" is synonymous with Contractor, General Contractor, Discharger, Operator, and Primary Permittee, as used in language of permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references.
- C. Qualified Person: For the purposes of this item, the term "Qualified Person" means a person, as used in language of permits, laws, rules, regulations, ordinances, and other soil erosion and sediment control references, who has successfully met certain education requirements and been certified as Level 1A, as prescribed by the Georgia Soil and Water Conservation Commission in consultation with the Georgia EPD and the Stakeholder Advisory Board.
- D. Other Definitions: Definitions as listed in the NPDES General Permit shall apply in this section.

1.4 WORK INCLUDED

- A. The Contractor shall furnish all labor, equipment, and materials necessary for implementing best management practices (BMPs) to prevent and minimize erosion and resultant sedimentation in all disturbed areas (cleared and grubbed) during and after construction. This item covers the Work necessary for the installation of structures and measures for the prevention and control of soil erosion and sedimentation. The Contractor shall furnish all material, labor, and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting, and removal (where applicable) of erosion and sediment control measures, and to cause compliance with the referenced documents in Section 1.02B of this specification.
- B. The Work covered under this item shall include the furnishing, placement, maintenance, and removal of BMPs to include, but not limited to: check dams, construction exits, diversion dikes and ditches, temporary sediment barriers, inlet sediment traps, storm drain outlet protection, surface roughening, buffer zone, dust control; providing information for, and signing Notice of Intent and Notice of Termination; all monitoring, record keeping, and reporting per the Comprehensive Monitoring Program (the CMP); and all temporary and permanent vegetative and non-vegetative ground cover; and all labor, materials, and equipment necessary to complete the Work as specified, as indicated on the Drawings, or as directed by the Owner.
- C. The Designer, Engineer, or the Owner, may at any time during the project, direct the Contractor to provide additional erosion and sediment control measures, as necessary, to adequately control erosion and sedimentation in order to comply with all permits.

1.5 SUBMITTALS

- A. Submit for approval, in accordance with Section 01 33 00 SUBMITTAL PROCEDURES all working drawings and schedules of materials and methods proposed to be followed in the execution of the Work under this item.
- B. Contractor shall submit to Engineer the proposed schedule for installation, maintenance, and removal of all temporary, permanent erosion, and sediment control measures. The

schedule shall reflect the requirements of the section titled, Sequence of Construction of Temporary Sediment Control Measures, and must show the anticipated starting and completion date for all land disturbance activities including:

1. Installation of temporary and permanent erosion and sediment control structures.
2. Stormwater management facilities, if any.
3. Timber salvage operations, Clearing, Grubbing, Demolition.
4. Utility pipe installation.
5. Rough and finished grading.
6. Paving
7. Landscaping, including all temporary mulching and seeding.
8. Cleanup and restoration
9. Landscaping, including all permanent seeding and sodding.
10. Removal of temporary erosion and sediment control structures.

1.6 NOTICE OF INTENT (NOI)

- A. When land disturbance construction activities are equal to or greater than one (1.0) acre, and an Erosion Sediment & Pollution Control Plan has been approved by the governing jurisdiction, the Contractor, with input from the Owner shall prepare a Notice of Intent. Contractor shall provide to the Owner and the Owner shall submit a properly executed NOI to Georgia EPD at least fourteen (14) calendar days prior to start of land disturbance activities.

1.7 MONITORING AND REPORTING

- A. Monitoring: The Contractor shall be responsible for the implementation of the Comprehensive Monitoring Program (CMP) as written by the Designer. The implementation must comply with EPD guidelines as set forth in the NPDES Permit referenced in Section 1.02B Sampling Requirements, Reporting, and Retention of Records.
- B. Reporting: The Contractor shall prepare and submit a summary of the monitoring results to the Engineer, the Designer and the EPD as required in the NPDES permit (Current Address: Northwest Georgia Regional Office, Georgia Environmental Protection Division, Suite 114, 4244 International Parkway, Atlanta, GA 30354). The Owner reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor in this section.

1.8 NOTICE OF TERMINATION (NOT)

- A. When all construction activities have ceased, final stabilization has been certified, and the site is in compliance with the NPDES permit, the Contractor, together with the Owner shall submit a Notice of Termination.

1.9 SPECIFIC REQUIREMENTS

- A. The requirements as specified, as indicated on the Drawings, are minimum requirements for the preventing or minimizing soil erosion and sediment transport. Contractor shall install and maintain soil erosion and sediment control measures in accordance with the

requirements set forth in the 2016 Manual for Erosion and Sediment Control in Georgia and said manual shall govern in case of conflicting information, unless an item is clearly identified on the Drawings as a deviation from the Manual.

1.10 REGULATORY COMPLIANCE

- A. Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States, the State of Georgia, and/or the local issuing authority, and fourteen (14) calendar days have passed since the Notice of Intent (NOI) has been properly filed with Georgia EPD. Contractor is the Primary Permittee and Operator under the provisions of the NPDES General Permit. As such, Contractor shall be required to sign certain certifications as described in the NPDES General Permit. Contractor shall comply with requirements specified in the Contract Documents, or as directed by the Engineer. Contractor shall also comply with all other laws, rules, regulations, ordinances, and requirements concerning soil erosion and sediment control established in the United States, the State of Georgia, and/or the local issuing authority. The referenced documents in Section 1.02B of this specification define the regulatory requirements for this item.

PART 2 NOT USED

PART 3 EXECUTION

3.1 GENERAL

- A. Every effort shall reasonably be employed by the Contractor to control erosion with the use of, but not limited to, terraces, grassing, and silt fencing during the project. All erosion and sedimentation control measures or facilities, whether temporary or permanent, shall be continuously maintained by the Contractor so as to be effective, or as ordered by the Owner.

3.2 BUFFER ZONE

- A. Buffer zone is an undisturbed zone or "green belt" surrounding the site, bordering streams or environmentally sensitive areas. Contractors shall not trespass on or in these areas unless they have prior acceptance by the Owner. Trespass in these areas will not be permitted unless there is no alternative method to accomplish the task. Cost shall not come into consideration in the evaluation of this type of request.

3.3 CONSTRUCTION EXITS

- A. Locate construction exits as shown on the Drawings or as directed by Owner.
- B. Installation: Construction exits should be located at all points where traffic shall be leaving the construction site to a public or private right of way, street, alley, or parking area. All construction exits must be fully installed prior to the commencement of timber salvage, clearing, grubbing, grading, or construction operations.
- C. Maintenance: In accordance with the section titled Inspections and Maintenance, all construction exits shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of rainfall an event that has precipitation of $\frac{1}{2}$ inch or greater. At the earlier of (1) thirty (30) calendar

days since construction exit was installed or last maintained, or (2) geotextile liner is visible or if construction exit does not conform to specifications established in this section, construction exit pad shall be top dressed with NSA's R-2 (1-½ inch to 3-½ inch stone) such that liner is no longer visible and exit pad conforms to specifications.

3.4 ROCKS CHECK DAMS

- A. Install rock check dams as shown on the Drawings or as directed by Owner.
- B. Installation: Install check dams in all ditches, channels, or swales draining disturbed areas of one acre or greater and which are not installed with permanent, non-erodible lining or a vegetative cover as specified in the section titled Temporary Soil Erosion Stabilization (Vegetative). The specifications for the design criteria, materials, installation, and maintenance of check dams are dependent on the upslope drainage area and are described below. A check dam shall not drain a disturbed area greater than two acres.
 - 1. Install rock check dams in ditches draining upgrade areas less than two acres. Construct check dam with Type 3 Rip Rap. Hand placement may be required to ensure complete coverage of the entire width of ditch.
- C. Maintenance: In accordance with the section titled Inspections and Maintenance, all check dams shall be inspected, and maintenance performed, if needed, within 24 hours of inspection once every 7 calendar days and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Dress dams with appropriately sized stone or additional straw bales as necessary to maintain check dams in accordance with these specifications. At the earlier of (1) every 14 calendar days, or (2) when sediment reaches a depth of ½ the original check dam height, all soil, silt, sediment and other material captured by the dam should be removed and returned upgrade on the construction site.

3.5 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

- A. Install all erosion and sediment control structures specified herein and shown in the Contract Documents, or as directed by Owner, as the first item of Work within a given drainage area. Construction and installation of all sediment control structures shall begin downgrade of the area to be disturbed and precede upgrade. Contractor shall, at all times, maintain all soil erosion and sediment control structures and practices throughout construction and until permanent grass cover is established.
- B. Time: Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the Local Issuing Authority.
- C. County Inspectors shall be contacted by the Contractor and given the date, time and location of the pre-construction meeting.

3.6 TEMPORARY STREAM CROSSING

- A. A temporary structure installed across a flowing stream or watercourse for use by construction equipment.
- B. This standard provides a means for construction vehicles to cross streams or watercourses without moving sediment into streams, damaging the streambed or channel, or causing flooding.

- C. Temporary stream crossings should not be used on streams with drainage areas greater than one square mile, unless specifically designed to accommodate the additional drainage area by the design professional.
- D. The structure shall be large enough to convey the full bank flow of the stream, typically flows produced by a 2-year, 24-hour frequency storm, without appreciably altering the stream flow characteristic.
- E. The temporary stream crossing shall be perpendicular to the stream.
- F. Temporary Culvert Crossing:
 - 1. The invert elevation of the culvert shall be installed on the natural streambed grade.
 - 2. The culvert(s) shall extend a minimum of one foot beyond the upstream and downstream toe of the aggregate placed around the culvert. In no case shall the culvert exceed 40 feet in length.
 - 3. The culvert(s) shall be covered with a minimum of one foot of coarse aggregate. If multiple culverts are used, they shall be separated by a minimum of 12 inches of compacted coarse aggregate fill.
 - 4. Culverts may be CMP or HDPE pipe.
- G. The structure shall be inspected after every rainfall and at least once a week, whether it has rained or not, and all damages repaired immediately. The structure shall be removed immediately after construction is finished, and the streambed and banks must be stabilized.

3.7 CONCRETE TRUCK WASHOUT

- A. Concrete truck washout practice allows for a sanitary location to capture waste after poured in place concrete activities are complete.
- B. The washout facility shall be located at least 50 ft. away from storm drains, open ditches and any water body.
- C. Excess, unused concrete shall not be emptied into the washout facility but properly disposed of at an off-site facility.
- D. The washout facility consists of a depression as detailed in the Drawings that has been fully lined with polyethylene plastic sheeting, minimum thickness of 10 mil.
- E. Sandbags, lath and flagging shall be installed on all sides.

3.8 TEMPORARY STOCKPILE AREA

- A. Temporary stockpile shall be located in a flat location within project limits.
- B. Stockpile shall be bordered by silt fencing leaving a single opening for equipment to safely pass through.
- C. A minimum of 1 ft. of space shall exist between the stockpile base and silt fence.
- D. The opening shall face uphill so as any runoff is captured by the silt fence.

- E. Stockpile slope shall not exceed 1:1. Stockpile height shall not exceed 10 ft. The stockpile base length, or diameter, shall not exceed 50 ft.

3.9 DISTURBED AREA STABILIZATION

- A. Vegetative cover will be placed on completed areas. This vegetative plan will be carried out on road cut and fill slopes, shoulders, and other critical areas created by construction. Plant grass seed as soon as construction in an area is completed. Planting will be made to control erosion, to reduce damage from sediment and runoff to downstream areas and to improve the safety and beauty of the development area.
- B. Due to grading and construction, the areas to be treated are mainly subsoil and substrate. Fertility is low and the physical characteristics of the exposed material are unfavorable to all but the most hardy plants.
- C. Conventional Seeding Equipment - Grade, shape and smooth where needed to provide for safe equipment operation at seeding time and for maintenance purposes. The lime and fertilizer in dry form will be spread uniformly over the area immediately before seedbed preparation. A seedbed will be prepared by scarifying to a depth of 1 to 4 inches as determined on site. The seedbed must be well pulverized, smoothed and firmed. Seeding will be by either a cultipacker-seeder, drill, rotary seeder, mechanical seeder, hand seeder or hydro-seeding. Seed will be distributed uniformly over a freshly prepared seedbed and covered lightly. Within 24 hours after seeding, with exception to hydro-seeding, straw or hay mulch will be spread uniformly over the area, leaving about 25 percent of the ground surface exposed. Mulch will be spread with blower-type mulch equipment or by hand and anchored immediately after it is spread. A disk harrow with the disk set straight or a special packer disk may be used to press the mulch into the soil.

3.10 DUST CONTROL ON DISTURBED AREAS

- A. Dust raised from vehicular traffic will be controlled by wetting down the access road with water or by the use of a deliquescent chemical, such as calcium chloride, if the relative humidity is over 30 percent. Chemicals shall be applied in accordance with the manufacturer's recommendations. Calcium chloride, anionic asphalt emulsion, latex emulsion or resin- in-water emulsion may be used for dust control.

3.11 STONE PLACEMENT

- A. The minimum thickness or depth of the stone layer shall be shown on the drawings or the detail with which the device is associated. When used with a plastic filter fabric, the stone placing shall begin in a trench at the bottom of the slope with the filter fabric wrapped in stone. The entire mass of stone shall be placed so as to be in conformance with the lines, grades, and thickness shown on the drawings.

3.12 RIPRAP

- A. Riprap shall be placed in accordance with the notes on the drawings. Any rip rap that shall be permanent shall have an underlayment of filter fabric.

3.13 STORM DRAIN OUTLET PROTECTION

- A. Storm drain outlets shall be paved or have a rock or other energy dispersion device associated with it, as called for on the drawings. The length shall be a minimum of six (6) times the pipe diameter and placed on a 1 percent grade unless otherwise specified on the drawings.

3.14 SITE RESTORATION

- A. The site shall be restored in a manner suitable to accommodate the erosion control device or system of devices for the use which they are intended.

3.15 TOPSOIL

- A. If topsoil is stripped and stored on site to be used after construction, the stockpile side slopes shall be 2:1 or flatter. Stockpiled topsoil shall not obstruct natural drainage. Topsoil replacement shall be spread at minimum of 4-inch thickness.

3.16 SITE SAFETY

- A. The Contractor shall incorporate and utilize all necessary fencing and other safety barriers as necessary, or directed by Owner, to prevent trespassing into potentially dangerous areas of the erosion control area.

END OF SECTION

SECTION 31 41 00
SHEETING, SHORING, AND BRACING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Sections:
 - A. Sections 01 32 33 "Photographic Documentation" and 01 14 19 - "Use of Site" for recording preexisting conditions and excavation support and protection system progress.
 - B. Section 31 23 19 - "Dewatering" for dewatering system for excavations.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.
 - A. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - B. Prevent surface water from entering excavations by grading, dikes, or other means.
 - C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - D. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings:
 - A. For excavation support and protection system.
- B. Delegated-Design Submittal:
 - A. For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - B. Coordinate first paragraph below with qualification requirements in Section 01 40 00 - "Quality Requirements" for qualified professional engineer.
- C. Other Informational Submittals:
 - A. Photographs or Videotape: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of,

the installation of, or the performance of excavation support and protection systems. Submit before Work begins.

- B. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 QUALITY ASSURANCE

- A. Preinstallation Conference:
 - A. Conduct conference at Project site.
 - a. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - 1) Geotechnical report.
 - 2) Existing utilities and subsurface conditions.
 - 3) Proposed excavations.
 - 4) Proposed equipment.
 - 5) Monitoring of excavation support and protection system.
 - 6) Working area location and stability.
 - 7) Coordination with waterproofing.
 - 8) Abandonment or removal of excavation support and protection system.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities:
 - A. Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
 - a. Notify Construction Manager no fewer than two days in advance of proposed interruption of utility.
 - b. Do not proceed with interruption of utility without Construction Manager's written permission.
- B. Project-Site Information:
 - A. A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from the data.
 - a. Additional test borings and other exploratory operations necessary for excavation support and protection shall be at no additional cost to Owner.
 - b. The geotechnical report is referenced elsewhere in the Project Manual.
- C. Survey Work:
 - A. Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

- a. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General:
 1. Provide materials that are either new or in serviceable condition.
- B. Structural Steel:
 1. ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.
- C. Steel Sheet Piling:
 1. ASTM A328/A328M, ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.
- D. Wood Lagging:
 1. Lumber, mixed hardwood, nominal rough thickness of size and strength required for application
- E. Shotcrete:
 1. Comply with specifications for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete:
 1. ACI 301, of compressive strength required for application.
- G. Reinforcing Bars:
 1. ASTM A615/A615M, Grade 60 (Grade 420), deformed.
- H. Tiebacks:
 1. Steel bars, ASTM A722/A722M.
 2. Steel strand, ASTM A416/A416M.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 1. Shore, support, and protect utilities encountered.

- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
 - 1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 - 2. Maintain tiebacks in place until permanent construction can withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary, to move brace, install new bracing before removing original brace.
 - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
 - 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction can withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
 - 1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 - 2. Fill voids immediately with approved backfill compacted to density specified in Section 31 23 00.
 - 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

32 12 16	Asphalt Paving
32 13 13	Concrete Paving
32 31 13	Chain Link Fences and Gates
32 92 00	Grassing

SECTION 32 12 16
ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cold milling of existing hot-mix asphalt pavement.
 - 2. Hot-mix asphalt patching.
 - 3. Hot-mix asphalt paving.
 - 4. Hot-mix asphalt paving overlay.
 - 5. Asphalt surface treatments.
 - 6. Pavement-marking paint.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation conference: Conduct conference at the Project site to review procedure.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
 - 1. Job-Mix Formulas and Designs: For each job mix proposed for the Work.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Material Certificates: For each paving material, from manufacturer.
- D. Material Test Reports: For each paving material.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the Georgia DOT.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Georgia DOT for asphalt paving work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
 - 1. Prime Coat: Minimum surface temperature of 60 degrees F
 - 2. Tack Coat: Minimum surface temperature of 60 degrees F
 - 3. Slurry Coat: Comply with weather limitations in ASTM D3910.
 - 4. Asphalt Base Course: Minimum surface temperature of 40 degrees F and rising at time of placement.
 - 5. Asphalt Surface Course: Minimum surface temperature of 60 degrees F at time of placement.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F for oil-based materials, 55 degrees F for water-based materials, and not exceeding 95 degrees F

PART 2 PRODUCTS

2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- D. Mineral Filler: ASTM D242, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

- A. Asphalt Binder: Comply with Georgia DOT Standard specification in sections 820.2 and 828.
- B. Asphalt Cement: ASTM D3381 for viscosity-graded material.
- C. Prime Coat: Asphalt emulsion prime coat complying with Georgia DOT requirements.
- D. Tack Coat: Comply with Georgia DOT section 413.

2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires asphalt shingles or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: ASTM D1073, Grade Nos. 2 or 3.
- D. Paving Geotextile: AASHTO M288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D6690, hot-applied, single-component, polymer-modified bituminous sealant.
- F. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M248, Type N; colors complying with FS TT-P-1952.
 - 1. Color: White, Yellow.
- G. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.
 - 1. Color: White, Yellow.
- H. Glass Beads: AASHTO M247, Type 1.
- I. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.
- J. Wheel Stops: Solid, integrally colored, 96 percent recycled HDPE or commingled postconsumer and postindustrial recycled plastic; UV stabilized; 4 inches high by 6 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.
 - 2. Adhesive: As recommended by wheel-stop manufacturer for application to asphalt pavement.

2.4 MIXES

- A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

- B. Open Graded Friction course: Open-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:
 - 1. Provide mixes with a history of satisfactory performance in the geographical area where Project is located.
 - 2. Materials shall meet the requirements of the NAPA's Design, Construction, and Maintenance of Open-Graded Friction Courses, Information Series 115 (2002), except where noted otherwise or approved in writing by the Engineer.
 - 3. Comply with the Georgia DOT Standard Specification Sections 828 for Open-graded friction course mixes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph
 - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.
- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
 - 1. Mill to a depth of 1-1/2 inches
 - 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
 - 3. Control rate of milling to prevent tearing of existing asphalt course.
 - 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
 - 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
 - 6. Transport milled hot-mix asphalt to asphalt recycling facility.
 - 7. Keep milled pavement surface free of loose material and dust.

3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
 - 2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate in accordance with Georgia DOT Standard Specification Section 413.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
 - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
 - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
 - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
 - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 - 1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
 - 1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
 - 2. Protect primed substrate from damage until ready to receive paving.
- D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate in accordance with Georgia DOT Standard Specification Section 413.
 - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
 - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
 - 2. Place hot-mix asphalt surface course in single lift.
 - 3. Spread mix at minimum temperature of 250 degrees F.
 - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
 - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
 - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat to joints.
 - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
 - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
 - 4. Construct transverse joints at each point where paver ends the day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
 - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
 - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
 - 1. Complete compaction before mix temperature cools to 185 degrees F
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 - 1. Average Density: 96 percent of reference laboratory density according to ASTM D6927, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Base Course: Plus, or minus 1/2 inch
 - 2. Surface Course: Plus 1/4 inch no minus.

ATTENTION: Total thickness shall be within 3/8 inch of the thickness specified based on testing provided by the Geotechnical Engineer. Failure to meet this requirement is cause for rejection.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straight edge applied transversely or longitudinally to paved areas:
 - 1. Base Course: 1/4 inch
 - 2. Surface Course: 1/8 inch
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch
- C. Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.10 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils
 - 1. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb./gal.

3.11 WHEEL STOPS

- A. Install wheel stops in bed of adhesive as recommended by manufacturer.
- B. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Traffic-Calming Devices: Finished height of asphalt speed bumps above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979.
 - 1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726.
 - a. One core sample will be taken for every 1,000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow milled materials to accumulate on-site.

END OF SECTION

SECTION 32 13 13
CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Driveways.
 - 2. Roadways.
 - 3. Curbs and gutters.
 - 4. Walks and plaza areas.
- B. Related Sections:
 - 1. Section 03 30 00 for general building applications of concrete.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other Pozzolan, and ground granulated blast-furnace slag.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Indicate pavement markings, lane separations, and defined parking spaces. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- D. Other Action Submittals:
 - 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.

- 8. Joint fillers.
- B. Material Test Reports: For each of the following:
 - 1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Concrete Testing Service: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures.
- E. ACI Publications: Comply with ACI 301 unless otherwise indicated.

1.6 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic.
- B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 degrees F for oil-based materials or 55 degrees F for water-based materials, and not exceeding 95 degrees F

PART 2 PRODUCTS

2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
 - 1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Reinforcement: ASTM A185/A185M, fabricated from as-drawn galvanized-steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Reinforcement: ASTM A497/A497M, flat sheet.
- C. Epoxy-Coated Welded Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- D. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed.
- E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.
- F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.
- G. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.
- H. Plain-Steel Wire: ASTM A82/A82M, as drawn.
- I. Deformed-Steel Wire: ASTM A496/A496M.
- J. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A coated, deformed.
- K. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.
- L. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.
- M. Tie Bars: ASTM A615/A615M, Grade 60 deformed.
- N. Hook Bolts: ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A780.

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150, white Portland cement Type I Type II Type I/II Type III Type V. Supplement with the following:
 - a. Fly Ash: ASTM C618, Class C or Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C33, Class 4S Class 4M Class 1N, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications.
 - 1. Maximum Coarse-Aggregate Size: 1-inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Exposed Aggregate: Selected, hard, and durable; washed; free of materials with deleterious reactivity to cement or that cause staining; from a single source, with gap-graded coarse aggregate as follows:
 - 1. Aggregate Sizes: 1/2 to 3/4-inch nominal.
 - 2. Aggregate Source, Shape, and Color:
- D. Water: Potable and complying with ASTM C94/C94M.
- E. Air-Entraining Admixture: ASTM C260.
- F. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.

- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
 - b. BASF Construction Chemicals, LLC; Confilm.
 - c. ChemMasters; Spray-Film.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; VaporAid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation, Inc.; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; D.O.T. Resin Cure.
 - d. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - e. Edoco by Dayton Superior; DSSCC Clear Resin Cure.
 - f. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
 - g. Kaufman Products, Inc.; Thinfilm 420.
 - h. Lambert Corporation; AQUA KURE - CLEAR.
 - i. L&M Construction Chemicals, Inc.; L&M CURE R.
 - j. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
 - k. Nox-Crete Products Group; Resin Cure E.
 - l. SpecChem, LLC; PaveCure Rez.
 - m. Symons by Dayton Superior; Resi-Chem Clear.
 - n. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
 - o. TK Products, Division of Sierra Corporation; TK-2519 DC WB.

- p. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
- F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B, dissipating.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Curing Compound #2 WP WB.
 - b. ChemMasters; Safe-Cure 2000.
 - c. Conspec by Dayton Superior; D.O.T. Resin Cure White.
 - d. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
 - e. Edoco by Dayton Superior; Resin Emulsion Cure V.O.C. (Type II).
 - f. Euclid Chemical Company (The), an RPM company; Kurez VOX White Pigmented.
 - g. Kaufman Products, Inc.; Thinfilin 450.
 - h. Lambert Corporation; AQUA KURE - WHITE.
 - i. L&M Construction Chemicals, Inc.; L&M CURE R-2.
 - j. Meadows, W. R., Inc.; 1100-WHITE SERIES.
 - k. SpecChem, LLC; PaveCure Rez White.
 - l. Symons by Dayton Superior; Resi-Chem White.
 - m. Vexcon Chemicals Inc.; Certi-Vex Enviocure White 100.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.
- B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.
- C. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types II, non-load bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Exposee.
 - b. Conspec by Dayton Superior; Delay S.
 - c. Dayton Superior Corporation; Sure Etch (J-73).
 - d. Edoco by Dayton Superior; True Etch Surface Retarder.

- e. Euclid Chemical Company (The), an RPM company; Surface Retarder Formula S.
 - f. Kaufman Products, Inc.; Expose.
 - g. Meadows, W. R., Inc.; TOP-STOP.
 - h. Metalcrete Industries; Surfard.
 - i. Nox-Crete Products Group; CRETE-NOX TA.
 - j. Scofield, L. M. Company; LITHOTEX Top Surface Retarder.
 - k. Sika Corporation, Inc.; Rugasol-S.
 - l. SpecChem, LLC; Spec Etch.
 - m. TK Products, Division of Sierra Corporation; TK-6000 Concrete Surface Retarder.
 - n. Unitex; TOP-ETCH Surface Retarder.
 - o. Vexcon Chemicals Inc.; Certi-Vex Envioset.
- F. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of Portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H S-Q Hardener.
 - b. BASF Construction Chemicals, LLC; Mastercron.
 - c. ChemMasters; ConColor.
 - d. Conspec by Dayton Superior; Conshake 600 Colortone.
 - e. Dayton Superior Corporation; Quartz Tuff.
 - f. Euclid Chemical Company (The), an RPM company; Surfex.
 - g. Lambert Corporation; COLORHARD.
 - h. L&M Construction Chemicals, Inc.; QUARTZPLATE FF.
 - i. Metalcrete Industries; Floor Quartz.
 - j. Scofield, L. M. Company; LITHOCHROME Color Hardener.
 - k. Southern Color N.A., Inc.; Mosaics Color Hardener.
 - l. Stampcrete International Ltd.; Color Hardener.
 - m. Symons by Dayton Superior; Hard Top.
 - 2. Color: As selected by Architect from manufacturer's full range.
- G. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.6 DETECTABLE WARNING MATERIALS

- A. Detectable Warning Stamp: Semirigid polyurethane mats with formed underside capable of imprinting detectable warning pattern on plastic concrete; perforated with a vent hole at each dome.
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.
 - b. Matcrete Precision Stamped Concrete Tools.

- c. Southern Color N.A., Inc.
 - d. Stampcrete International Ltd.
 - e. Superior Decorative by Dayton Superior.
- 2. Size of Stamp: One piece matching detectable warning area shown on Drawings.
- B. Liquid Release Agent: Manufacturer's standard, clear, evaporating formulation designed to facilitate release of stamp mats.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Surfaces Inc.; Liquid Release.
 - b. Matcrete Precision Stamped Concrete Tools; Liquid Release Agent.
 - c. Southern Color N.A., Inc.; SCC Clear Liquid Release.
 - d. Stampcrete International Ltd.; Stampcrete Liquid Release.
 - e. Superior Decorative by Dayton Superior; Pro Liquid Release.

2.7 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, Type N; colors complying with FS TT-P-1952.
 - 1. Color: White.
- B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.
 - 1. Color: White.
- C. Glass Beads: AASHTO M 247, Type 1.

2.8 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 3,000-psi minimum compressive strength, 6 inches high by 8 inches wide by 72 inches long. Provide chamfered corners and drainage slots on underside and holes for anchoring to substrate.
 - 1. Dowels: Galvanized steel, 1/2 inch in diameter, 24-inch minimum length.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to ACI 301 for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.
- B. Proportion mixtures to provide normal-weight concrete with the following properties:
 - 1. Maintain Compressive Strength (28 Days) as follows:
 - a. Curb and Gutter: 3,500 psi
 - b. Footings: 3,000 psi

- c. Bollards: 3,000 psi
- d. Pond Outlet Control Structure: 3,000 psi
- e. Grease Traps: 4,000 psi
- f. Drainage Structures: Per GDOT Standard
- g. Dumpster Pad and Conc. Approach Pad: 5,000 psi
- h. Standard Sidewalk: 3,000 psi
- i. 12-feet wide, fiber-reinforced Sidewalk: 3,500 psi
- j. 12-feet wide, fiber-reinforced heavy-duty sidewalk: 4,000 psi
- k. Concrete paving and Plaza area: 4,000 psi
- l. Dugout: 3,000 psi
- 2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
- 3. Slump Limit: 4 inches plus or minus 1 inch
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - 1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.
 - 2. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
 - 3. Air Content: 5 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions after Architect's approval only.
- F. Cementitious Materials: Limit percentage by weight of cementitious materials other than Portland cement according to ACI 301 requirements as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Ground Granulated Blast-Furnace Slag: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or Pozzolan not exceeding 25 percent.
- G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb./cu. yd.
- H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85- and 90-degrees F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd. increase mixing time by 15 seconds for each additional 1 cu. yd.
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph
 - 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
 - 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 31 23 00.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Provide tie bars at sides of paving strips where indicated.
 - 3. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
 1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to require cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.
- L. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 - 1. When air temperature has fallen to or is expected to fall below 40 degrees F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- M. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared, and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8-inch-deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

- A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
 1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
- B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.
 1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third

of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.

4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb./100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
 2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage and embed by power floating.
 3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 4. After curing, lightly work surface with a steel wire brush or abrasive stone and water to expose nonslip aggregate.

3.9 DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units.
1. Tolerance for Opening Size: Plus 1/4 inch no minus.
- B. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
1. Before using stamp mats, verify that the vent holes are unobstructed.
 2. Apply liquid release agent to the concrete surface and the stamp mat.
 3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begin to come through all of the vent holes. Gently remove stamp mats.
 4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.
 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.

- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb./sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture, curing moisture-retaining-cover curing, curing compound, or a combination of these as follows:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.11 PAVING TOLERANCES

- A. Comply with tolerances in ACI 117 and as follows:
 - 1. Elevation: 3/4-inch
 - 2. Thickness: Plus 3/8 inch minus 1/4 inch
 - 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch
 - 4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
 - 5. Lateral Alignment and Spacing of Dowels: 1 inch.
 - 6. Vertical Alignment of Dowels: 1/4 inch
 - 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
 - 8. Joint Spacing: 3 inches
 - 9. Contraction Joint Depth: Plus 1/4 inch no minus.
 - 10. Joint Width: Plus 1/8 inch no minus.

3.12 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

- B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
 - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
 - 2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb./gal.

3.13 WHEEL STOPS

- A. Install wheel stops in bed of adhesive applied as recommended by manufacturer.
- B. Securely attach wheel stops to paving with not less than two galvanized-steel dowels located at one-quarter to one-third points. Install dowels in drilled holes in the paving and bond dowels to wheel stop. Recess head of dowel beneath top of wheel stop.

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 5,000 sq. ft. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 degrees F and below and when it is 80 degrees F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

- C. Strength of each concrete mixture will be satisfactory if average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength.
- D. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

3.15 REPAIRS AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Engineer, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chain link fencing and associated access gates.

B. Type:

1. Fencing shall be chain link type with galvanized mesh and steel posts.
2. Gate shall be swing-type or rolling cantilever type.

1.2 RELATED SECTIONS

A. This section contains specific references to the following related sections. Additional related sections may apply that are not specifically listed below.

1. Section 03 30 00 Cast-in-Place Concrete
2. Section 31 10 00 Site Preparation

1.3 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM A121	Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
ASTM A392	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A780	Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A824	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence

Reference	Title
ASTM A1011/A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM F552	Standard Terminology Relating to Chain Link Fencing
ASTM F567	Standard Practice for Installation of Chain-Link Fence
ASTM F626	Standard Specification for Fence Fittings
ASTM F900	Standard Specification for Industrial and Commercial Swing Gates
ASTM F1043	Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
ASTM F1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F1184	Standard Specifications for Industrial and Commercial Horizontal Slide Gates
ASTM F1916	Standard Specification for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications
UL 467	Grounding and Bonding Equipment

1.4 DEFINITIONS

- A. Terms as defined in ASTM F552.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination
1. See Section 01 12 16 Work Sequence.
 2. Complete necessary Site preparation and grading before installing chain link fence and gates.
 3. Interruption of Existing Utility Service: Notify owner of utility 72 hours prior to interruption of utility services. Do not proceed with interruption of utility service without written permission from utility owner.
- B. Unit Responsibility
1. Assign unit responsibility, as specified, to the fence supplier for all items specified in this Section. Provide a completed and signed Unit Responsibility Certification Form (Form 43 05 11-C, Section 01 99 90).

1.6 SUBMITTALS

- A. Action Submittals:
1. Procedures: Section 01 33 00.
 2. Shop Drawings:
 - a. Product Data: Include construction details, material descriptions, dimensions of individual components, and finishes for chain link fences and gates.
 - 1) Fence, gate posts, rails, and fittings.
 - 2) Chain link fabric.

- 3) Gates and hardware.
 - 4) Accessories: Barbed wire.
- 3. Test Reports: Field test result for compliance of installation of chain link fence, gates, and gate operators.
- B. Informational Submittals:
 - 1. Procedures: Section 01 33 00.
 - 2. Manufacturer's recommended installation instructions.
 - 3. Evidence of Supplier and installer qualifications.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Procedures: Section 01 66 00.

PART 2 PRODUCTS

2.1 GENERAL

- A. Match style, finish, and color of each fence component with that of other fence components and fittings.
- B. All fence components and fittings shall be black vinyl coated.
- C. Provide Aluminum-grade Warning signages at adequate spaced intervals along the fence, at gateways and whenever there is a change of direction to visually warn people of the existence of potential hazards

2.2 CHAIN LINK FENCE FABRIC

- A. Galvanized fabric conforming to ASTM A392, Type II, Class 1, 1.2 ounces per square foot; galvanized after weaving.
- B. Height: 96 inches, unless otherwise shown.
- C. Core Wire Gauge: No. 9.
- D. Pattern: 2-inch diamond-mesh.
- E. Diamond Count: Manufacturer's standard and consistent for fabric furnished of same height.
- F. Loops of Knuckled Selvages: Closed or nearly closed with space not exceeding diameter of wire.

- G. Wires of Twisted Selvages:
 - 1. Twisted in a closed helix three full turns.
 - 2. Cut at an angle to provide sharp barbs that extend minimum 1/4 inch beyond twist.

2.3 POSTS

- A. General:
 - 1. Strength and Stiffness Requirements: ASTM F1043, light industrial fence, except as modified in this section.
 - 2. Round Steel Pipe, Schedule 40: ASTM F1083.
 - 3. Roll-Formed Steel Shapes: Roll-formed from ASTM A1011/A1011M, Grade 45, High-Strength Low-Alloy steel.
 - 4. Lengths: Manufacturer's standard with allowance for minimum embedment below finished grade of 34 inches.
 - 5. Protective Coatings:
 - a. Zinc Coating: ASTM F1043, Type A external and internal coating.
- B. Line Posts:
 - 1. Round Steel Pipe:
 - a. Outside Diameter: 2.375 inches.
- C. End, Corner, Angle, and Pull Posts:
 - 1. Round Steel Pipe:
 - a. Outside Diameter: 2.875 inches.
 - b. Weight: 5.79 pounds per foot.
- D. Posts for Removable Fence Panels: As specified for end, corner, angle, and pull posts.
- E. Posts for Swing Gates 8 Feet High and Under:
 - 1. ASTM F900.
 - 2. Round Steel Pipe:
 - a. Outside Diameter: 4.00 inches.
 - b. Weight: 6.56 pounds per foot.
- F. Posts for Swing Gates Over 8 Feet High: As recommended by fence manufacturer.

2.4 TOP AND BRACE RAILS

- A. Galvanized Round Steel Pipe:
 - 1. ASTM F1083.
 - 2. Outside Diameter: 1.66 inches.
 - 3. Weight: 2.27 pounds per foot.
- B. Galvanized Roll-Formed Steel C Shapes:
 - 1. Roll formed from ASTM A1011/A1011M, Grade 45.
 - 2. Outside Dimensions: 1.625 inches by 1.25 inches.

- 3. Weight: 1.40 pounds per foot.
- C. Protective Coatings: As specified for posts.
- D. Strength and Stiffness Requirements: ASTM F1043, top rail, light industrial fence.

2.5 FENCE FITTINGS

- A. General: In conformance with ASTM F626, except as modified by this article.
- B. Post and Line Caps: Designed to accommodate passage of top rail through cap, where top rail required.
- C. Tension and Brace Bands: No exceptions to ASTM F626.
- D. Tension Bars:
 - 1. One-piece vinyl clad.
 - 2. Length not less than 2 inches shorter than full height of chain link fabric.
 - 3. Provide one bar for each gate and end post, and two for each corner and pull post.
- E. Truss Rod Assembly: 3/8-inch diameter, steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- F. Tie Wires, Clips, and Fasteners: According to ASTM F626.
- G. Barbed Wire Supporting Arms: Pressed steel or cast-iron with clips, slots, or other means for attaching strands of barbed wire integral with post cap for each post, with single 45-degree arms for supporting three strands of barbed wire. Arms shall withstand 250 pounds of downward pull at outermost ends of the arms without failure.

2.6 TENSION WIRE

- A. Zinc-coated steel marcelled tension wire conforming to ASTM A824 Type II, Class 2.

2.7 BARBED WIRE

- A. Zinc-Coated Barbed Wire: ASTM A121, Chain Link Fence Grade.

2.8 GATES

- A. General:
 - 1. Gate Operation: Opened and closed easily by one person.
 - 2. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F1043 and ASTM F1083 for materials and protective coatings.
 - 3. Frames and Bracing: Fabricate members from round galvanized steel tubing with outside dimension and weight according to ASTM F900.
 - 4. Gate leaves more than 8-feet wide shall have intermediate tubular members and diagonal truss rods to provide rigid construction, free from sag or twist.
 - 5. Gate Fabric Height: Same as for adjacent fence height.
 - 6. Welded Steel Joints: Paint with zinc-based paint.

7. Chain Link Fabric: Attached securely to gate frame at intervals not exceeding 15 inches.
 8. Gate Posts and Frame Members: Extend gateposts and frame end members above top of chain-link fabric at both ends of gate frame to attach barbed wire assemblies.
 9. Latches: Arranged for padlocking so padlock will be accessible from both sides of gate.
- B. Swing Gates: Comply with ASTM F900 for single and double swing gate types.
1. Leaf Width: As shown.
 2. Hinges: Offset type, malleable iron.
 - a. Furnished with large bearing surfaces for clamping in position.
 - b. Designed to swing either 180 degrees outward, 180 degrees inward, or 90 degrees in or out, as shown, and not twist or turn under action of gate.
 3. Latches: Plunger bar arranged to engage stop, except single gates of openings less than 10 feet wide may each have forked latch.
 4. Gate Stops: Mushroom type or flush plate with anchors, suitable for setting in concrete.
 5. Locking Device and Padlock Eyes: Integral part of latch, requiring one padlock for locking both leaves of double gate.
 6. Hold-Open Keepers: Designed to automatically engage gate leaf and hold it in open position until manually released.
- C. Cantilever Horizontal Sliding Gates:
1. Comply with ASTM F1184 for single slide gate Type I, Class 2 with internal roller assemblies.
 2. Overhead Track Assemble: Manufacturer's standard track, with overhead framing supports, bracing, and accessories, designed to support size, weight, width, operation, and design of gate and roller assemblies.
 3. Roller Guards: As required per ASTM F1184 for Type II, Class 2 gate.
 4. Hangers, roller assemblies, and stops fabricated from galvanized malleable iron.

2.9 GATE OPERATOR SYSTEM (NOT USED)

2.10 REMOVABLE FENCE PANELS

- A. Panel Length:
1. Equal division of total length of removable fence section.
 2. Maximum 10 feet.
- B. Frames: ASTM F1184, Type I.

2.11 CONCRETE

- A. Provide as specified in Section 03 30 00, Cast-in-Place Concrete.

2.12 FENCE GROUNDING

- A. Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 - 1. Material above Finished Grade: Copper.
 - 2. Material on or below Finished Grade: Copper.
 - 3. Bonding Jumpers: Braided copper tape, 1-inch wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Connectors and Grounding Rods: Comply with UL 467.
 - 1. Connectors for Below-Grade Use: Exothermic welded type.
 - 2. Grounding Rods: Copper-clad steel.

PART 3 EXECUTION

3.1 GENERAL

- A. Install chain link fences and gates in accordance with ASTM F567, except as modified in this section, and in accordance with fence manufacturer's recommendations, as approved by Engineer. Erect fencing in straight lines between angle points.
- B. Provide necessary hardware for a complete fence and gate installation.
- C. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A780.
- D. Drainage Crossings: Where the chain-link fence must cross drainage ditches or swales, the main fence shall be carried across a ditch or swale with additional fence added below.
 - 1. Frames and Bracing: The fence added below shall be fabricated with galvanized round steel pipe conforming to the requirements for top and brace rails.
 - 2. The construction of the frame shall be welded or assembled with corner fittings. The frame shall be rigid and to the extent necessary to maintain a 2-inch clearance between bottom of the frame and finish grade. If necessary, to maintain rigidity, attach to the frame a series of 3/8-inch diameter galvanized steel pipe stakes that are embedded a minimum of 2 feet to the sides and bottom of the ditch.
 - 3. Attach chain link fabric securely to frame at intervals not exceeding 12 inches.

3.2 PREPARATION

- A. Clear area on either side of fence to the extent specified in Section 31 10 00, Site Preparation. Eliminate ground surface irregularities along fence line to the extent necessary to maintain a 2-inch clearance between bottom of fabric and finish grade.
- B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 POST SETTING

- A. Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil. Driven posts are not acceptable. Postholes shall be clear of loose materials. Waste materials from postholes shall be removed from Site or regraded into slopes on Site.
- B. Posthole Depth:
 - 1. Minimum 3 feet below finished grade.
 - 2. Two (2) inches deeper than post embedment depth below finish grade.
- C. Set posts with minimum embedment below finished grade of 34 inches and with top rail at proper height above finished grade. Verify posts are set plumb, aligned, and at correct height and spacing. Brace posts, as necessary, to maintain correct position and plumbness until concrete sets.
- D. Backfill postholes with concrete to 2 inches above finished grade. Vibrate or tamp concrete for consolidation. Protect above ground portion of posts from concrete splatter.
- E. Before concrete sets, crown and finish top of concrete to readily shed water.
- F. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- G. Line Posts: Space line posts uniformly at 10 feet on centers between terminal end, corner, and gate posts.

3.4 POST BRACING

- A. Install according to ASTM F567, maintaining plumb position, and alignment of fencing. Install braces at gate, end, pull, and corner posts diagonally to adjacent line posts to ensure stability. Install braces on both sides of corner and pull posts.
 - 1. Locate horizontal braces at mid-height of fabric or higher, on fences with top rail, and 2/3-fabric height on fences without top rail. Install so posts are plumb when diagonal truss rod assembly is under proper tension.

3.5 TOP RAILS

- A. Install according to ASTM F567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps and terminating into rail end attached to posts or posts caps fabricated to receive rail at terminal posts. Install top rail sleeves with springs at 105 feet maximum spacing to permit expansion in rail.

3.6 BARBED WIRE SUPPORTING ARMS

- A. Barbed wire supporting arms shall be installed as indicated and as recommended by manufacturer. Bolt or rivet supporting arm to top of post in a manner to prevent easy removal with hand tools. Angle single arms to outside of fence.

3.7 TENSION WIRE

- A. Install according to ASTM F567 and ASTM F1916, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with tie wires at a maximum spacing of 24 inches on center.
- B. Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

3.8 CHAIN LINK FABRIC

- A. Do not install fabric until concrete has cured minimum 7 days.
- B. Apply fabric to outside of enclosing framework. Pull fabric taut to provide a smooth and uniform appearance free from sag, without permanently distorting fabric diamond or reducing fabric height. Tie fabric to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- C. Splicing shall be accomplished according to ASTM F1916 by weaving a single picket into the ends of the rolls to be joined.
- D. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated.
- E. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.
- F. Tie Wires: Fasten ties to wrap a full 360 degrees around rail or post and a minimum of one complete diamond of fabric. Twist ends of tie wire three full twists and cut off protruding ends to preclude untwisting by hand.
 - 1. Maximum Spacing: Tie fabric to line posts at 12 inches on center and to brace and top rails at 24 inches on center.

3.9 BARBED WIRE

- A. Install barbed wire uniformly in configurations of three strands of barbed wire on supporting arms. Pull wire taut and install securely to supporting arms and secure to end terminal post or terminal arms.

3.10 GATES

- A. Install gates according to manufacturer's written instructions, level, plumb and secure for full opening without interference. Attach fabric and hardware to gate using tamper-resistant or concealed means. Adjust hardware for smooth operation and lubricate where necessary so gates operate satisfactorily from open or closed position.
- B. Set gate stops in concrete to engage center drop rod or plunger bar.

3.11 GATE OPERATOR SYSTEM (NOT USED)

3.12 ELECTRICAL GROUNDING

- A. Ground fences at a maximum interval of 1,000 feet in accordance with applicable requirements of IEEE C2, National Electrical Safety Code.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.
- C. Grounding Method: At each grounding location, drive a grounding rod vertically until top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

3.13 FIELD QUALITY CONTROL

- A. Post and Fabric Testing: Test fabric tension and line post rigidity according to ASTM F1916.
- B. Gate Tests:
 - 1. Prior to acceptance of installed gates, demonstrate proper operation of gates under each possible open and close condition specified.
 - 2. Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
 - 3. Confirm that latches and locks engage accurately and securely without forcing and binding.

3.14 MANUFACTURER'S SERVICES

- A. Provide manufacturer's representative at Site in accordance with Division 1, General Requirements to train Owner's personnel to adjust, operate, and maintain gates.

3.15 CLEANUP

- A. Remove excess fencing materials and other debris from Site.

END OF SECTION

SECTION 32 92 00
GRASSING

PART 1 NOT USED

PART 2 PRODUCTS

2.1 MATERIALS GENERAL

- A. The Contractor shall, at the time of delivery, furnish the Engineer and Owner invoices of all materials received in order that the application rate of materials may be determined.

2.2 FERTILIZER

- A. A 10-10-10, commercial fertilizer of accepted type, conforming to state fertilizer laws.

2.3 LIME

- A. Lime shall be agricultural grade, ground limestone and shall conform to the requirements of the Georgia Department of Agriculture. Lime to be added based on soil tests.

2.4 SEED

- A. All seed shall conform to all State Laws and to all requirements and regulations of the Georgia Department of Agriculture.
- B. The several varieties of seed shall be individually packaged or bagged, and tagged to show name of seed, net weight, origin, germination, lot number, and other information required by the Department of Agriculture.
- C. The Engineer reserves the right to test, reject, or accept all seed before seeding.
- D. Mixtures of different types of seed called for in the seeding schedule shall be weighted and mixed in the proper proportions at the site of the work in the presence of the Engineer.

2.5 SEEDING SCHEDULE

- A. Hulled Bermuda Seeds are to be used at a rate of 40 pounds per acre, and at a depth of 1/4 to 1/8 inch. Pure line seed to be 82% by weight, with a maximum weed seed of 0.50 percent.
- B. In shaded areas, or other areas as directed by the Owner or Engineer, the Contractor shall use a mixture of hulled Bermuda seed at a rate of 25 pounds per acre and carpet seed at a rate of 30 pounds per acre.
- C. Temporary grassing shall consist of annual rye grass seed at a rate of 75 pounds per acre.
- D. In areas where existing grasses are to be matched, the Contractor shall sow the seed at the rate recommended by the seed distributor.

2.6 STRAW MULCH

- A. Straw mulch material shall consist of straw or hay. Straw shall be stalks of wheat, rye, barley, oats, or other accepted straw. Hay shall consist of timothy, peavine, alfalfa, coastal bermuda or other grasses from accepted sources. These materials shall be reasonably dry and shall be reasonably free from mature seed-bearing stalks, roots, or bulblets or Johnson Grass, Nutgrass, Sandbur, Wild Garlic, Wild Onion, Wild Mustard, Crotalaria, Pigweed, Witchweed and Coclebur. The Contractor shall also comply with all State and Federal domestic plant quarantine regulations.

2.7 EXCELSIOR MULCH

- A. Excelsior mulch shall consist of wood fibers cut from sound, green timber. The average length of the fibers shall be 4 to 6 inches. The cut shall be made in such a manner as to provide maximum strength of fiber, but at a slight angle to the natural grain of the wood so as to cause splintering of the fibers when weathering in order to provide adherence to each other and to the soil.

2.8 WOOD CELLULOSE FIBER MULCH

- A. Wood cellulose fiber mulch shall be made from wood chips particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer. It shall remain in uniform suspension in water under agitation and blend with grass seed and fertilizer to form a homogenous slurry. The mulch fibers shall intertwine physically to form a strong moisture holding mat on the ground surface and allow rainfall to percolate the underlying soil. The mulch shall be heat processed so as to contain no germination or growth-inhibiting factors. It shall be dyed (non-toxic) an appropriate color to facilitate metering of material.
- B. Suppliers shall be prepared to certify that laboratory and field testing of their project has been accomplished, and that it meets all of the foregoing requirements based upon such testing.
- C. Weight specifications for this material from suppliers and for all applications shall refer only to air dry weight of fiber material. Absolute air-dry weight is based on the normal weight standard of the Technical Association of the Pulp and Paper Industry for wood cellulose and is considered equivalent to 10 percent moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.

2.9 SOD

- A. Sod shall be densely rooted, good quality centipede grass, free from noxious weeds. The sod shall be obtained from areas where the soil is reasonably fertile. The sod shall be raked free of all debris and the grass mowed to two inches before cutting. The sod shall contain practically all of the dense root system and not be less than one (1) inch thick. Sod shall be cut in uniform strips not less than twelve (12) inches in width and not less than twenty-four (24) inches in length.

2.10 PRODUCT REVIEW

- A. The Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3 EXECUTION

3.1 STAND OF GRASS

- A. Before acceptance of the seeding performed for the establishment of permanent vegetation, the Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and the winter weather and be capable of re-establishment in the spring.
- B. Before acceptance of the seeding performed for the establishment of temporary vegetation, the Contractor will be required to produce a stand of grass sufficient to control erosion for a given area and length of time before the next phase of construction or the establishment of permanent vegetation is to commence.

3.2 SEEDING DATES AND RATES OF APPLICATION

- A. Seeding shall be performed during the periods and at the rates specified in the seeding schedules. Seeding work may, at the discretion of the Contractor, be performed throughout the year using the schedule prescribed for the given period. Seeding work shall not be conducted when the ground is frozen or excessively wet. The Contractor will be required to produce a satisfactory stand of grass regardless of the period of the year the work is performed.

3.3 PREPARATION

- A. The areas to be seeded or sodded shall be made smooth and uniform and shall conform with the finished grade and cross section shown on the plans or as otherwise designated. Minor shaping and smoothing of uneven and rough areas outside the graded section shall be performed as directed by the Engineer in order to provide for more effective erosion control and for ease of subsequent mowing operations.
- B. The areas to be grassed, if not loose, shall be loosened to a minimum depth of 3 inches before agricultural lime, fertilizer, seed or sod is applied. The areas to be seeded shall be cleared of stones larger than 2 1/2 inches, in any dimension, roots, and other debris.

3.4 APPLYING LIME AND FERTILIZER

- A. Following advance preparation and placing selected material for shoulders and slopes when called for in the contract, lime if called for based on soil tests and fertilizer shall be spread uniformly over the designated areas and shall be thoroughly mixed with the soil to a depth of approximately 2 inches. Fertilizer shall be applied at the rate of 500 pounds per acre for the initial application, unless otherwise directed by the Engineer. Lime shall be applied at the rate determined by the soil test. Unless otherwise provided, lime will not be applied for temporary seeding. In all cases where practicable, acceptable mechanical spreaders shall be used for spreading fertilizer. On steep slopes subject to slides and inaccessible to power equipment, the slopes shall be adequately scarified. Fertilizer may be applied on steep slopes by hydraulic methods as a mixture of fertilizer and seed. When fertilizer is applied in combination seed and fertilizer drills, no further incorporation will be necessary. The fertilizer and seed shall be applied together when the method of seeding (Wood Cellulose Fiber Mulch) is used. Any stones larger than 2 1/2 inches in any dimension, larger clods, roots, or other debris brought to the surface shall be removed.

3.5 SEEDING

- A. Seed shall be sown within 24 hours following the application of fertilizer and lime and preparation of the seedbed as specified in paragraph 3.4. Seed shall be uniformly sown at the rate specified by the use of acceptable mechanical seed drills. Rotary hand seeders, power sprayers or other satisfactory equipment may be used on steep slopes or on other areas that are inaccessible to seed drills.
- B. The seeds shall be covered and lightly compacted by means of a cultipacker or light roller if the drill does not perform this operation. On slopes inaccessible to compaction equipment, the seed shall be covered by dragging spiked chains, by light harrowing or by other satisfactory methods.
- C. Apply water with fine spray immediately after each area has been sown.
- D. Do not sow seed when ground is too dry, during windy periods or immediately following a rain.
- E. All seeded areas seeded with permanent grasses shall be uniformly mulched in a continuous blanket immediately following seeding and compacting operations, using at least 2 tons of straw per acre.

3.6 SEEDING (EXCELSIOR MULCH)

- A. Seed shall be sown as specified in paragraph 3.5. Within 24 hours after the covering of seed, excelsior mulch shall be uniformly applied at the rate of 2 tons per acre. The mulch may be applied hydraulically or by other acceptable methods. Should the mulch be placed in a dry condition, it shall be thoroughly wetted immediately after placing. Light rolling of the mulch may be required to form a tight mat.

3.7 SEEDING (WOOD CELLULOSE FIBER MULCH)

- A. After the lime has been applied and ground prepared as specified in paragraph 3.4, wood cellulose fiber mulch shall be applied at the rate of 1,500 pounds per acre in a mixture of seed and fertilizer. Hydraulic equipment shall be used for the application of fertilizer, seed and slurry of the prepared wood pulp. This equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed and water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which will provide an even distribution of the slurry on the various areas to be seeded. The slurry tank shall have a minimum capacity of 1,000 gallons.
- B. The seed, fertilizer, wood pulp mulch, and water shall all be combined into the slurry tank for distribution of all ingredients in one operation by the hydraulic seeding method specified herein. The materials shall be combined in a manner recommended by the manufacturer. The slurry mixture shall be so regulated that the amounts and rates of application shall result in a uniform application of all materials at rates not less than the amount specified. Using the color of the wood pulp as a guide, the equipment operator shall spray the prepared seedbed with a uniform visible coat. The slurry shall be applied in a sweeping motion, in an arched stream so as to fall like rain, allowing the wood fibers to build upon each other until an even coat is achieved.

3.8 SODDING

- A. Sod shall be placed between March 1st and December 1st.
- B. Sod shall be placed within 48 hours of cutting.
- C. Sod shall be moist when laid and placed on moist ground. The sod shall be carefully placed by hand, beginning at the toe of slopes and working upwards. The length of the strips shall be at right angles to the flow of surface water. All joints shall be tightly butted, and end joints shall be staggered at least 12 inches. The sod shall be immediately pressed firmly into the ground by tamping or rolling. Fill all joints between strips with fine screened soil. Sod on slopes shall be pegged with sod pegs to prevent movement. The sod shall be watered, mowed, weeded, repaired or otherwise maintained, to insure the establishment of a uniform healthy stand of grass until acceptance.

3.9 MAINTENANCE

- A. Maintain seeded and sodded surfaces until final acceptance.
- B. Maintenance shall consist of providing protection against traffic, watering to ensure uniform seed germination and to keep surface of soil damp, and repairing any areas damaged as a result of construction operations or erosion.

3.10 ACCEPTANCE

- A. Before release of the performance bond on the seeding and sodding performed for the establishment of permanent vegetation, the Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and the winter weather and be capable of reestablishment in the spring.

END OF SECTION

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

DIVISION 33

UTILITIES

33 16 19 Composite Elevated Tank

SECTION 33 16 19.01

COMPOSITE ELEVATED TANK

PART 1 GENERAL

1.1 DESCRIPTION

A. SCOPE OF WORK:

1. The work to be performed under these specifications includes furnishing all labor, materials, tools, and equipment necessary to design, fabricate, construct, inspect and test a welded steel elevated water storage tank supported on a concrete support structure, including the foundation and accessories as shown on the drawings and specified herein.

The work shall also include all labor, materials, and equipment necessary to clean, paint and disinfect the water storage tank as specified herein.

B. RELATED WORK:

1. The work shall also include all labor, materials, and equipment necessary to construct the site improvements and site piping as shown on the drawings and specified herein.

C. DESCRIPTION:

1. The tank and support structure shall be the composite elevated tank style as designed and constructed by CB&I, Caldwell Tanks, Inc., Landmark Structures, Inc., or Engineer or Owner approved equal. The tank shall be of all welded steel design and have a dome or conical roof, straight sides, and a cone bottom. The support structure shall be of concrete design. The concrete support structure shall be configured so that a concrete tank floor with a steel liner plate supports the water inside the steel reservoir. Suspended steel tank floor configurations will not be allowed.

D. FAA NOTIFICATION:

1. In accordance with the owner's FAA Determination Letter for this project. The Contractor is responsible for any updates, temporary permits, construction notifications, approvals or site measures.

1.2 PRE-QUALIFICATION OF CONTRACTOR

- A. Bids will only be accepted from experienced contractors who have successfully completed at least ten composite elevated tanks of equal or greater capacity. Each bidder shall provide a list of at least five such projects stating location, completion date, contact names and telephone numbers.
- B. The composite elevated tank and foundation design, concrete support structure construction and welded steel tank fabrication and construction shall be performed by the Contractor's own direct hire employees and shall not be subcontracted in any way. The tank's foundation may be supervised and installed by the Contractor or a qualified local foundation subcontractor. The Contractor shall employ a full-time Professional Engineer with a minimum of five (5) years cumulative experience in the design and construction of Composite Elevated Tanks. The engineer shall be registered in accordance with these specifications and shall be in responsible charge of the work.

1.3 STANDARDS, CODES AND GUIDES

- A. The following standards and specifications are referenced. The latest edition shall be used if the edition is not specified.

Reference	Title
AWWA D107	Standard for Composite Elevated Tanks for Water Storage
AWWA D102	Standard for Painting Steel Water Storage Tanks
AWWA C652	Standard for Disinfection of Water Storage Facilities
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ACI 301	Specifications for Structural Concrete for Buildings
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
NSF 61	Drinking Water System Components
OSHA	Occupational Safety and Health Standards
SSPC-PA1	Paint Application Specification

- B. The Specifications, Codes and Standards referenced shall govern the work with regard to materials, design, construction, inspection and testing to the extent specified.
- C. The Composite Elevated Tank shall be designed and constructed in compliance with applicable federal, state and local regulations.
- D. Personnel safety equipment shall be provided in accordance with OSHA requirements and the manufacturers' documentation.

1.4 DELIVERY, STORAGE, & HANDLING

- A. Handling and Shipping
1. The Contractor shall handle materials and fabricated components in a manner that will protect them from damage. Allow painted materials adequate cure time prior to stacking or shipping.
- B. Storage and Protection
1. Protect delivered materials and equipment from damage. Store in well drained areas and provide blocking to minimize contact with the ground.

1.5 SUBMITTALS

- A. Each Contractor shall submit with their bid a sketch of the composite elevated tank showing major dimensions and plate thicknesses. A sketch of the foundation showing preliminary dimensions and approximate quantities of concrete and reinforcing steel shall also be provided with the proposal.
- B. Prior to construction, the contractor shall furnish construction drawings of the tank, concrete support structure and foundation sealed by a Professional Engineer licensed in

the State of Georgia. Construction drawings for the foundation shall show applicable design and construction standards, materials of construction, design loads and allowable soil bearing or pile capacity.

- C. A summary of the design for the foundation, support structure and the tank shall be provided prior to construction. The design summary shall show applicable design and construction standards, materials of construction, design loads and results showing conformance with the specifications. The design shall be sealed by a Professional Engineer licensed in the State of Georgia.
- D. Welder's certifications shall be submitted in accordance with AWWA D107.
- E. Provide an operating and maintenance manual containing operating instructions, maintenance instructions, as-built construction drawings, cleaning and painting instructions, a gage table and catalog cuts of equipment supplied.

PART 2 PRODUCTS

2.1 GENERAL

- A. Furnish an elevated water storage tank as shown on the drawings and as specified in this section. The design, materials, fabrication, construction, testing and inspection of the tank, support structure and foundation shall comply with AWWA D107, except as modified herein. The tank capacity, head range and the height to TCL shall be as shown on the drawings. Tank net capacity shall be 750,000 gallons.

2.2 MATERIALS

- A. Materials and material tests used for reinforced concrete shall conform to ACI 318 except as modified herein.
- B. The same brand and type of cement and aggregate from a consistent source shall be used throughout the construction of the concrete support structure to maintain uniformity of color.
- C. The minimum specified compressive strength of concrete shall be 4000 psi. The specified compressive strength of concrete used for the design of the wall and dome shall not exceed 6000 psi and 5000 psi, respectively.
- D. Deformed bar reinforcing steel shall conform to ASTM A615 Grade 60 or ASTM A706 Grade 60. Plain welded wire reinforcement shall conform to ASTM A185.
- E. Materials and material tests for the steel tank and all tank components shall comply with the latest edition of AWWA D107 except as modified herein.

2.3 DESIGN CRITERIA

- A. GENERAL
 - 1. Dead load shall be the estimated weight of all permanent construction and fittings. The unit weight of steel shall be considered as 490 pounds per cubic foot and the unit weight of concrete shall be taken as 144 pounds per cubic foot.

2. Water load shall be the weight of the water when the tank is filled to the overflow. The unit weight of water shall be 62.4 pounds per cubic foot.
3. Snow load shall be in accordance with AWWA D107.
4. Wind loads shall be based on AWWA D107 and exposure category C in accordance with ASCE 7 for Category IV (essential facility) structures.
5. Horizontal and vertical seismic loads shall be based on AWWA D107 for Category IV (essential facility) structures, using tank center coordinates of 31.2969 latitude and -81.4837 longitude. The site classification shall be as specified in the geotechnical report.
6. The structural effects of the applied loads shall be considered with the loads defined according to ASCE 7. Load combinations used for allowable stress design and strength design shall conform to AWWA D107 Section 4.3.

B. FOUNDATION

1. The design of the foundation shall conform to ACI 318 except as modified herein.
2. The foundation design shall be by the Contractor and shall conform to the recommendations given in the geotechnical report. The foundation depth shall be as required for the extreme frost penetration shown in AWWA D107.
3. Earth cover shall be a minimum of 4 feet over top of pipe in accordance with AWWA D107. Any pipe passing through the foundation which does not meet this minimum cover requirement shall be properly insulated until such minimum cover is achieved.
4. Unless modified by the Geotechnical Engineer, the foundation shall be sized to provide a safety factor of 3.0 against the ultimate soil bearing capacity in accordance with AWWA D107. For driven pile the safety factor shall be at least 2.0. Safety factors may be reduced to 2.25 and 1.5 respectively when direct vertical loads are combined with wind or seismic.
5. The foundation shall be sized such that there is a minimum safety factor of 1.5 against overturning for wind or seismic events using service load combinations.
6. Foundation piling shall conform to the design and detailing requirements of International Building Code (IBC) Section 1810, including the supplemental design and detailing requirements based on the assigned Seismic Design Category (SDC).

C. CONCRETE SUPPORT STRUCTURE

1. The design of the concrete support structure shall conform to AWWA D107 and ACI 318 except as modified herein.
2. The minimum wall thickness shall not be less than 8 inches exclusive of rustications or other architectural relief.
3. The concrete support structure walls shall have a minimum reinforcement ratio in accordance with AWWA D107 Table 13. Where the seismic design category determined in accordance with ASCE 7 is D, E or F, the minimum reinforcement ratio shall be 0.25 percent in the vertical and horizontal directions.
4. The concrete support structure walls shall have reinforcement placed in two layers in each direction with 50 percent of the minimum required steel in each layer.

5. The vertical load capacity for walls shall be determined using the procedures in AWWA D107 Section 6.3.
6. Horizontal reinforcement shall be provided to resist the ovaling of the wall due to wind pressure, using the procedures in AWWA D107 Section 6.3.
7. The concrete support structure walls shall be designed to resist in plane shear using the procedures in AWWA D107 Section 6.3. The effect of openings shall be considered in the shear design.
8. Openings in the concrete support structure walls that are less than or Engineer and Owner approved equal to 24 inches and are isolated do not require a beam and column analysis. Isolated openings shall have a clear distance between openings equal to 0.75 times the cumulative width of adjacent openings. Additional reinforcement having an area of not less than 1.2 times the area of interrupted reinforcement shall be distributed equally to either side of openings. Openings shall have a minimum of one No. 5 reinforcing bar placed diagonally in each corner. All reinforcements shall be fully developed beyond the opening.
9. Openings larger than 24 inches or combinations of openings that are not isolated shall be designed using an effective beam and column analysis as per AWWA D107 Section 6.3. Vertical and horizontal reinforcement shall be provided around the opening in accordance with the requirements of this section.
 - a. The corners of the openings shall be reinforced with diagonal bars. The area of bars provided shall be equal to the minimum horizontal reinforcement ratio times the column area. A minimum of two No. 5 reinforcing bars shall be placed diagonally in each corner.
 - b. Reinforcement provided around openings shall be fully developed. Column reinforcement shall extend the greater of half the opening height or the development length above and below the opening or be developed into the foundation. Horizontal reinforcement shall extend the greater of the development length past the midpoint of the column or a minimum of half a development length beyond the column.
10. Local effects at openings shall be considered when the opening is located less than half the opening width above the foundation. The foundation shall be designed to adequately develop the opening reinforcement and redistribute loads across the unsupported width.

D. CONCRETE TO TANK INTERFACE

1. The concrete to tank interface region includes those portions of the concrete support structure and welded steel tank that are affected by the transfer of forces between the concrete tank floor, ring beam, tank cone bottom and support structure wall. The design of the interface region shall be based on an analysis using finite element or similar analysis which can accurately model the interaction of the intersecting elements. The analysis shall provide results including the shear, moment and compression or tension caused by the intersecting elements in the interface region.
2. The analysis shall consider the transfer of forces from the intersecting elements under all anticipated load conditions. These conditions shall include the eccentricity of loads, restraint effects caused by shrinkage and temperature differentials, long term effects caused by concrete creep, and the effect of anchorage of the welded steel tank to the concrete.

3. The geometry of the interface region shall provide positive drainage at the top of the wall and ringbeam. Condensation or precipitation shall not be allowed to accumulate in this area.
4. The geometry of the tank shall be established such that the ringbeam provided at the top of the wall is a compression member with gravity loads acting alone ($D + F$). In this loading condition the compressive stress in the ringbeam shall be not less than 50 psi to minimize cracking in the interface region. No direct tension in the ringbeam under this loading condition will be allowed. The maximum compression in the ringbeam shall be no greater than $0.18f'_c$.
5. The ringbeam shall be reinforced as a compression member with a minimum longitudinal reinforcement ratio of 0.40 percent. Tie reinforcement shall be provided in accordance with ACI 318 for compression members as a minimum. Additional tie reinforcement shall be provided if required by the analysis of the interface region.
6. When a concrete dome supports the tank contents, it shall not be less than 9 inches thick, or less than the mean spherical radius of the dome divided by 50. The minimum reinforcement ratio shall be 0.36 percent in orthogonal directions. The reinforcement shall be placed in two layers with 50 percent of the minimum required steel in each layer.

E. WELDED STEEL TANK

1. The design for all sections of the steel tank shall be per the unit tension/compression stresses allowed for material classes listed in the latest edition of AWWA D107. Designing per Section 14 of AWWA D100 shall not be permitted.
2. The tank shall have a domed or conical steel roof to minimize snow accumulating and water ponding on the roof plates. Roof plates and supporting structure shall be designed to support the full snow load per AWWA D107.
3. For areas of the steel tank where the water is supported by a steel cone, the cone plate thickness may be determined using a nonlinear buckling analysis. A nonlinear buckling analysis may only be performed for liquid filled cones with a thickness-to-radius ratio greater than 0.0010 and less than 0.0030. The angle of the cone measured from the axis of revolution to the plate surface shall not exceed 60 degrees. If a nonlinear buckling analysis is not performed, the cone plate thickness shall be determined in accordance with the shell stability formulas provided in AWWA D107.
 - a. The nonlinear buckling analysis shall include the effects of material and geometric non-linearities, residual stresses and imperfections.
 - b. The imperfection considered in the analysis shall have a magnitude of not less than $0.04(Rt)^{1/2}$, where R is the radius normal to the plate measured to the axis of revolution, and t is the corroded plate thickness. The length of the imperfection shall be equal to or less than $4(Rt)^{1/2}$ and be appropriate for the type of construction used for the cone. The location and shape of the imperfection shall produce the lowest critical buckling stress.
 - c. The minimum specified yield strength of the cone plate material shall be equal to or greater than 36 ksi. The yield strength used for the analysis shall be no greater than 40 ksi when the material of construction has a minimum specified yield strength greater than 40 ksi.
 - d. Plate thickness used for the cone plates shall be no less than 80 percent of that required by the shell stability formulas provided in AWWA D107 when the thickness to radius ratio is greater than or Engineer and Owner approved equal to 0.00143.

Cone plate thickness shall be no less than 70 percent of that required by AWWA D107 when the thickness to radius ratio is less than 0.00143.

- e. The nonlinear buckling analysis shall demonstrate that the provided cone plate thickness has a factor of safety of at least 2.0 against buckling in the corroded condition.
4. The concrete tank floor shall be covered with a welded steel liner to provide a watertight boundary. The minimum thickness of the liner plate shall be 1/4-inch. Liner plates may be placed directly on the concrete when the liner plates are formed to match the shape of the tank floor. Liner plates that are not formed to match the shape of the tank floor shall have the space between the liner plates and the tank floor completely filled with a flowable grout.
5. Unless otherwise noted, at junctions in plates where meridional forces are discontinuous such as cone to cylinder junctions, a tension or compression ring may be required to resist the radial forces generated. In these regions, the allowable stresses shall not exceed those referred to in AWWA D107.
 - a. Tension ring stresses shall not exceed the lesser of 15,000 psi or one half of the minimum specified yield of the plate material.
 - b. Compression ring stresses shall not exceed 15,000 psi.
 - c. To determine the stresses in the ring due to discontinuity forces, the tank plates immediately adjacent to the discontinuity may be assumed to participate for a distance of $0.78(Rt)^{1/2}$.
6. Minimum plate thickness of all tank parts shall be in accordance with AWWA D107.

2.4 APPURTENANCES

A. EXTERIOR DOORS

1. Provide one 36-inch x 84-inch commercial steel door, 1 3/4-inch thick, 4 3/4-inch 16-gauge jamb, industrial duty type door closer and automatic door bottom, 1/4-inch tempered glass 6-inch x 27-inch. Door to be AMWELD series 1500 seamless door, with series 400 frame, or Engineer or Owner approved equal. Door shall be minimum 16-gauge and insulated with pre-formed polystyrene insulation. Door shall be thoroughly cleaned, phosphated and finished with one coat of baked-on rust inhibiting primer in accordance with ASTM B117 and ASTM D1735. Provide three (3) full mortises, 5 knuckle hinges, 4 1/2-inch x 4 1/2-inch minimum, two (2) floor stops, door weatherization kit. Hinges shall be steel, phosphated and primed coated for finish painting. Provide a complete and functional door lockset and tumbler-type lock, keyed to the owner's existing water production master key system. Door painting shall conform to the tank exterior paint system. Contractor to provide two spare keys per lockset.
2. Provide one manually chain operated 10-foot-wide x 12-foot-high overhead steel rolling door with hood located in the base of the support structure. Door slats shall be formed of 22-gauge steel with end locks and designed for a minimum 20-psf wind load. Steel curtain construction with high-grade zinc coating per ASTM A153 hot process, and phosphate coating for paint adhesion. Provide air baffle for entire upper barrel, curtain bottom bar with brush sealing, weather end lock on alternate slats and sealing strips for weather tightness. The door shall be equipped with slide bolt locks on both sides of interior bottom. Overhead door location shall be as shown on the drawings.
3. The door is to be finish painted by the manufacturer. The door provider shall submit manufacturer's finish color samples to the owner for selection of the finish color.

4. Provide two (2) 8-inch diameter steel safety posts on the exterior of the overhead door opening to protect the door from vehicle impact. Safety posts painted yellow shall be filled with concrete.

B. PIPING & PRESSURE RELIEF

1. A 12-inch diameter inlet/outlet pipe shall be provided from near the low point of the tank floor to a flanged connection at the base of the support structure. The inlet/outlet pipe shall be ASTM A240-304L material. Piping shall conform to ASTM A778, and welded fittings shall conform to ASTM A774. All pipe-to-pipe joints shall be welded. The pipe shall have a minimum thickness of schedule 10S but not less than 3/16-inch. Provide a stainless-steel expansion joint near grade to accommodate differential movements between the inlet/outlet pipe and concrete support structure. The inlet/outlet pipe shall be attached to the support structure with galvanized steel brackets spaced no more than 20 feet apart.
2. A 12-inch diameter overflow pipe equipped with an anti-vortex entrance shall be provided. The overflow pipe within the support structure shall be ASTM A240-304L material. Stainless-steel piping shall conform to ASTM A778, and welded fittings shall conform to ASTM A774. The pipe shall have a minimum thickness of schedule 10S but not less than 1/8-inch. Inside the tank, the overflow pipe shall conform to ASTM A53 Grade B and have a minimum thickness of 1/4-inch. All pipe-to-pipe joints shall be welded. The overflow shall be attached to the access tube and support structure, and discharge at a point approximately two feet above grade level onto a 10-foot x 25-foot x 1-foot concrete flume channel with a riprap configuration to properly dissipate the discharge of the water from the outfall.
3. The attachment to the support structure shall be with galvanized steel brackets spaced no more than 20 feet apart. The end of the overflow shall be covered with a No. 24 stainless steel mesh screen with a minimum of 1/8-inch neoprene gaskets between the discharge pipe and flap valve.
4. A 3-inch diameter drainpipe shall penetrate the tank at the low point of the tank floor. The drainpipe shall be fitted with a threaded plug and handle inside the tank and have a wall thickness equal to or greater than standard weight pipe. The drainpipe shall conform to ASTM A53 Grade B and all pipe-to-pipe joints shall be welded. An NSF approved flexible pipe shall be used to connect the drainpipe to the overflow pipe.
5. A minimum of one aluminum pressure-vacuum vent near the center of the roof shall be provided. The vent(s) shall be sized to handle pressure differential caused by water entering or leaving the tank at a maximum rate. The maximum inlet rate is 2,000 gpm, the maximum withdrawal rate is 2,000 gpm. The open area of the overflow shall not be considered as a venting area. The vent(s) shall have No. 24 stainless steel mesh screen insect screens and shall be designed to relieve any pressure or vacuum in the event the screen frosts over or is otherwise clogged and shall be easily dismantled for cleaning. The vent(s) shall be self-correcting. The pressure-vacuum vent may be mounted on the exhaust hatch.

C. ACCESS, LADDERS & PLATFORMS

1. Provide a galvanized steel ladder system attached to the support structure which extends from grade to the walkway and painters access manhole. This ladder system shall consist of a continuous straight run ladder with galvanized rest platforms provided at no more than 30 feet intervals. Intermediate rest platform to include OSHA compliant handrails. This ladder shall be equipped with a ladder safety cable system.
2. Provide a painted steel ladder on the interior of the access tube from the walkway to

- the tank roof. This ladder shall be equipped with a ladder safety cable.
3. Provide a galvanized steel ladder from the walkway to the tank bottom manhole. This ladder shall be equipped with ladder safety cable.
 4. The ladder safety cable shall be an OSHA approved galvanized system as manufactured by DBI Industries, or Engineer and Owner approved equal. Provide a removable extension for each ladder that does not extend 48 inches beyond the walkway level. The owner shall be supplied with two (2) new fall restraint systems: climbing devices; shock-absorbing lanyards; wire grab fall arrestor, and a full-body, buckle-type harness with front D-rings (one medium/large and one extra-large size).
 5. Provide a galvanized steel walkway immediately below the tank extending from the support structure to the access tube. The walkway shall be a minimum of 48 inches wide with 60-inch-high handrails.
 6. Provide an access tube located on the vertical centerline of the tank. The access tube shall have a minimum diameter of 48 inches. The access tube shall extend below the tank floor to the walkway level to provide continuous ladder access from the walkway to the tank roof.
 7. A ladder for access to the tank interior from the roof, shall be provided and attached to the access tube. This ladder shall be equipped with ladder safety cable.
- D. For safety considerations during antenna installation, and for maintenance, a 60-inch-high handrail shall be furnished with a top rail, intermediate rail, and toe board. Handrail shall be ~ 26-foot diameter and centered on the tank access tube roof hatch. The handrail shall also provide 12 attachment points spaced equally for the antennas. The handrail shall be 2 3/8-inch outer diameter, schedule 40 minimum. The handrail shall be designed to accommodate the following antennas (Antenna specifications included as technical data available to the contractor):
- a. (2) 874F-70-2 Tantalus Antennas
 - b. (10) 220-3BN Backup Radio Antennas
- E. ACCESS, MANHOLES, HATCHES & VENTS
1. One 24-inch x 36-inch painters access manhole/ventilation louver opening shall be provided giving access to the exterior painters' rail located at the top of the concrete support structure. This opening shall have a removable aluminum rainproof louver with bird screen to provide ventilation for the concrete support structure. The louver shall be accessible from the walkway.
 2. One 30-inch diameter tank bottom manhole shall be provided in the tank floor with access by ladder from the walkway.
 3. Two 30-inch diameter steel hatches shall be supplied. One shall be at the top of the access tube with spring assist, chain and inside handle. The other shall be adjacent to the access tube for entry into the tank and shall have a handle and hasp. The hatch openings shall have a curb four inches high and the cover shall have a downward overlap of two inches.
 4. One 24-inch diameter flanged exhaust hatch shall be supplied, located adjacent to the access tube and so constructed that an exhaust fan may be connected for ventilation during painting.
 5. One 24-inch diameter painters access manhole shall be provided adjacent to each interior painter's rail giving access from the roof. The 24-inch diameter exhaust hatch may be positioned to serve as one of these access manholes.

F. PAINTERS RAILS

1. Provide painters rails and an interior inspection rail as shown on the drawings and specified herein:
 - a. Interior Painters Rails. The rails shall be attached to the underside of the roof. Provide one rail near the center of the tank and one rail approximately 18 inches from the tank shell. If the slope distance between these two rails exceeds 32 feet, provide a third rail near midspan.
 - b. Exterior Painters Rail. The rail shall be located near the top of the support structure and be accessible from the walkway via the painters' access manhole/ventilation louver.
 - c. Interior Inspection Rail. The rail shall be located near the top of the support structure and be accessible from the walkway. The rail and support brackets shall be galvanized.
- G. ELECTRICAL
1. Interior waterproof light sockets with rigid conduit, wiring and switch shall be provided inside the support structure and access tube. Contractor to install the proper amount of light fixtures, electrical conduits, brackets, holders-mounts, and associated appurtenances to adequately illuminate the interior access space of the tank. The new electric LED light fixtures, switches, and associated wiring connected to the existing circuit shall not exceed the existing electrical service. Light switches for catwalks and bowl access must be located at those locations and on the ground floor.
 2. Install the proper amount of light fixtures, electrical conduits, brackets/mounts, and associated appurtenances to fully showcase and properly illuminate the new lettering and logos painted on each side of the tank. The new electric LED light fixtures, light glare shields, adjusting digital timer switches, light photocell sensor, and associated wiring connected to the existing circuit shall not exceed the existing electrical service.
 3. Electric service shall be provided and connected by contractor.
 4. Install new SCADA equipment, PLCs, HMIs, weatherproof box, controllers, panels, level transducers, multi-sensors, analyzer, alarms, conduits, electrical wires, holders-mounts, solar panel systems, communication devices, and associate appurtenance. Contractor to perform installation, programming, and functionality testing per JWSC SCADA requirements. All remote control and monitoring devices will be controlled by and communicated with the current JWSC SCADA system and existing operational standards.
- H. FAA OBSTRUCTION LIGHTING
1. Install new double LED FAA obstruction lighting fixtures, risers/posts, lighting controls, photocells, electrical conduit, electrical wires, and appurtenances in accordance with current FAA standards.
- I. LIGHTNING PROTECTION
1. Provide a lightning protection system for the elevated tank structure and any roof mounted equipment that may be damaged by lightning.
 2. Minimum requirements include two 28 strand by 14-gauge copper conductors bonded to the steel tank 180 degrees apart. The conductors shall be fastened to the interior support wall at 3 foot minimum spacing and shall terminate with buried 5/8-inch diameter by 8-foot-long copper clad ground rods.
- J. ANTENNA RAIL AND CABLE DETAILS
1. Contractor shall provide provisions and supports for SCADA and communication antennas with devices to the new tank. All brackets, guy wires, mast support and necessary penetrations shall be included.
 2. Provide all labor, materials, equipment, and installation to make all necessary provisions for future antenna cable(s) routing. This work includes but is not limited to

the following:

- a. Twelve 4-inch diameter pipe penetrations (with caps) in the support structure, located approximately two feet (2-feet) above the top of foundation.
- b. Twelve 4-inch diameter pipe penetrations (with caps) in the access tube cover.
- c. Suitable brackets welded to the inside of the support structure and access tube to safely secure future antenna cables. Bracket spacing shall not exceed 8 feet.

K. TANK MIXING SYSTEM

1. Furnish and erect a passive tank mixing system.
2. The storage tank mixing system shall accomplish thorough mixing of the tank contents. The mixing system shall function without the use of mechanical pumps or blowers or other equipment with motor drives or other continuously moving parts. The energy needed to mix the storage tank shall be provided solely by the flow of water through the tank inlet pipe. The mixing system shall distribute the fresh, newly-disinfected incoming water throughout the tank, reducing microbial growth and related tastes and odors.

L. PRESSURE TRANSMITTER

1. Furnish and install new pressure indicator and transmitter with stainless-steel ball valve.
2. Transmitter should be a Rosemount model# 2088G2S22A1K5.
3. The pressure indicator shall be from vendor Wika Instrument, LP mode# 212.34 or similar with a visible scale 0 – 160 psi.

M. SAMPLE TAPS

1. Furnish and install new three 1/2-inch sample taps with stainless-steel ball valve.

N. WATER SERVICE PROVISION

1. Install water service provisions for cleaning, washing down, and testing: 1-inch water service assembly with service saddle with fittings, CTS poly piping, tracer wire, water metering system, RPZ, and 1-inch frost-proof yard hydrant with brass vacuum breaker at 3-foot above grade installation on 2-foot by 2-foot by a 4-inch concrete pad. The Contractor is to coordinate with JWSC Operation for connection to the water distribution main.

O. SUMP PUMP

1. Install a new submersible sump pump in a sump pump pit at the basin/tank at the interior shaft of the tank. The new sump pump, piping, float switch, check valve, ball valve, and associated wiring connected to the existing circuit shall not cause additional electrical load. Sump pump piping to include a check valve that discharges into tank overflow piping.

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspection and testing shall be in accordance with AWWA D107. Shop subassembly

welds that require radiographic inspection shall be inspected in the shop or field. If radiographic inspection is performed in the shop, radiographs shall be provided to the Engineer prior to their delivery to the jobsite.

3.2 GENERAL

- A. All concrete formwork, placement and consolidation shall comply with ACI 318 and ACI 301 except as modified herein. Concrete tolerances shall comply with ACI 117 except as modified herein.
- B. Concrete placed in cold weather conditions shall be protected to prevent damage in accordance with ACI 306. The cold weather protection shall continue until the concrete has attained 35 percent of the specified compression strength and the allowable temperature differential can be maintained.
- C. Concrete placed in hot weather conditions shall be protected to prevent damage in accordance with ACI 305.
- D. Concrete shall be cured in conformance with ACI 318. Curing methods shall be continued until the concrete has reached a compressive strength that will allow for safe jumping of forms without causing damage to previously placed concrete.
- E. Concrete strength tests shall be taken in accordance with ACI 318 except as modified herein. Strength test samples shall be taken as the concrete is delivered from the truck. At least one strength test sample shall be taken for every day that concrete is placed. Additional strength test samples shall be taken for every 50 yd³ of concrete placed when the total daily pour is less than or Engineer and Owner approved equal to 150 yd³ and for every 150 yd³ of concrete placed when the total daily pour is greater than 150 yd³.
- F. Each strength test sample shall provide at least four 6-inch x 12-inch molded cylinders. Two cylinders will be used to establish the 28-day strength in accordance with ACI 318. One cylinder should be tested at 7 days to supplement the 28-day test. The fourth cylinder shall be a spare for the other cylinders.
- G. Inspection and testing of the welded steel tank shall comply with AWWA D107 Section 9.

3.3 CONCRETE FOUNDATION

- A. If, during excavation, conditions are encountered which differ from those given in the geotechnical report, appropriate adjustments to construction schedule and price will be negotiated.
- B. Inlet and outlet pipes and other penetrating pipes shown on the drawings extending 3 feet outside the foundation wall shall be included as part of the foundation.
- C. All exposed formed surfaces shall receive a smooth as-cast form finish and all unexposed formed surfaces shall receive a rough form finish. All exposed unformed surfaces shall receive a trowel finish and all unexposed unformed surfaces shall receive a float finish.
- D. Provide a 6-inch concrete slab at grade in the base of the support structure. The slab shall be placed over compacted structural backfill and shall be reinforced with #4 reinforcing steel at 12-inch centers each way. Provide 1/2-inch expansion material at the slab to foundation intersection and at floor penetrations. Provide saw-cut control joints

- E. at 18 foot maximum spacing. The slab shall be sloped towards the floor drain to the sump pump pit. The slab shall be constructed in accordance with the latest edition of ACI 301.

3.4 CONCRETE SUPPORT STRUCTURE

- A. The concrete support structure wall shall be constructed using a jump form process. The form system shall use curved, prefabricated form segments of the largest practical size to minimize panel joints. Concrete pour height shall be a minimum of 4 feet and a maximum of 12 feet. Form panels shall extend the full height of the concrete pour using only vertical panel joints. Formwork shall be secured using bolts through the wall prior to concrete placement. Working platforms that allow safe access for inspection and concrete placement shall be provided. Form facing material shall be metal, or plywood faced with plastic or fiberglass.
- B. The form system shall incorporate a uniform pattern of vertical and horizontal rustications to provide architectural relief to the exterior wall surface. Construction joints and formwork panel joints shall be located in rustications. Formwork panel joints shall be sealed using closures which combine with the form pattern to prevent grout leakage and panel joint lines. The top of each concrete placement shall be finished with a grade strip. The vertical and horizontal rustications shall be proportioned and combined to impart a symmetrical architectural pattern to the completed structure.
- C. Support wall forming system shall incorporate segmented concrete placement. Temporary vertical bulkheads shall divide the wall pour into segments that are less than a single batch of concrete. The bulkheads shall be located at rustications, braced rigid and tight to maintain vertical alignment under concrete load. Each segment shall be continuously placed with concrete to the full form height. Temporary bulkheads shall not be removed until adjacent concrete is placed.
- D. Formwork shall remain in place until the concrete has attained sufficient strength to support the form removal and subsequent loads without damage to the structure. The Contractor shall base formwork removal procedures and times on early-age test results. However, form movements and concrete placement shall be limited to a maximum of once per day.
- E. Dimensional tolerances for the concrete support structure shall be checked by the contractor prior to each pour and maintained as the structure is built. The tolerances for construction of the concrete support structure are:

1. Support wall variation:

Thickness	-3 percent, +5 percent
Diameter	0.4 percent \leq 3 inch
Vertical alignment:	
in any 10 feet of height	$\frac{1}{2}$ inch
in any 50 feet of height	1 inch
over total height	1 $\frac{1}{2}$ inch

2. Tank floor variation:

Slab floor thickness	-3 percent, +5 percent
Dome floor thickness	-6 percent, +10 percent
Dome floor radius	1 percent
Local deviation from true	3/4-inch
(Using a 5-foot sweep board)	

3. Level alignment variation:

From specified elevation	1 inch
From a horizontal plane	1/2 inch

4. Offset between formwork:

Exterior exposed surfaces	1/8 inch
Interior exposed surfaces	1/4 inch

All exterior exposed surfaces shall receive a smooth as-cast form finish. All interior exposed surfaces shall receive a rough as-cast form finish. All exposed surfaces shall be cleaned to remove surface contamination. All tie holes and concrete voids larger than 3/4-inch diameter and/or 1/2-inch deep shall be filled with a color matching nonshrink grout. All exposed surfaces shall be cleaned to remove any concrete paste leakage from higher placed concrete shaft rings. No additional finish of the exterior exposed surface is required unless excessive form oil remains on the concrete surface.

5. The top of the concrete tank floor shall receive a float finish.

3.5 WELDED STEEL TANK

- A. All welding shall comply with AWWA D107.
- B. All welding procedures, welders and welding operators shall be qualified in accordance with ASME Section IX for the processes and positions utilized.
- C. To minimize corrosion and rust staining on the underside of the roof, the underside roof plate laps and rafter-to-roof plate seams shall be seal welded. The minimum thickness for seal welded roof plates shall be 1/4 inch.
- D. The edges or surfaces of the pieces to be joined by welding shall be prepared by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping and shall be cleaned of detrimental oil, grease, scale and rust. The edges of the pieces may have a protective coating applied to them which need not be removed before they are welded unless specifically prohibited by the welding procedures.
- E. Field and shop welding may be done by the shielded metal arc welding process, the gas metal arc welding process, the flux core arc welding process and the submerged arc welding process.

- F. Plates and component members of the tank shall be assembled and welded following erection methods which result in a minimum of distortion from weld shrinkage. Surfaces to be welded shall be free from loose scale, slag, heavy rust, grease, paint, and other foreign material.
- G. The Contractor shall remove weld of slag, spatter, burrs and other sharp or rough projections. The surface of the weld shall be suitable for subsequent cleaning and painting operations.
- H. Full penetration butt-welded joints shall be inspected using the radiographic examination method. The number and location of the radiographs and the acceptance criteria shall be as required by AWWA D107. Inspection by sectional segments is not allowed.
- I. All liner plate welds shall be tested using the vacuum box testing method before the tank is painted.
- J. When the cone plate thickness has been determined using a nonlinear buckling analysis, the contractor shall measure the actual imperfections of the cone plates after welding. The measurements shall be taken in the meridional direction. Measurements shall be taken at each meridional weld seam and midway between each meridional weld seam. Where the actual imperfections exceed the tolerances assumed in the analysis, further evaluation will be required and corrective action such as reworking the shell or adding stiffeners may be required.
- K. In order to assist in the maximization of the paint's lifecycle, all welds on the tank exterior shall be ground smooth and blended to a NACE-D profile. All welds on the tank interior shall be ground smooth and blended to a NACE-D profile. Welds on the interior dry support column can remain in an as-welded condition but must have a profile adequate for the specified paint system. Contractor to provide third-party inspection to ensure compliance to this requirement.

PART 4 COATINGS & FINISHES (SEE SECTION 09 90 00)

4.1 TESTING AND STERILIZATION

- A. Sufficient cure, per the manufacturer's recommendations, of the final coat on the interior wet surface shall be allowed before the elevated tank is sterilized and filled with water.
- B. The tank shall be sterilized per the requirements of AWWA C652 Chlorination Method No. 2 or 3.
- C. The Owner, free of charge to the Contractor, shall furnish and dispose of sufficient water for the initial testing and sterilization. The water shall be at proper pressure to fill the tank to the maximum working level. Any leaks in the tank that are disclosed by this test shall be repaired by gouging out defective areas and re-welding. No repair work shall be done on any joint unless the water in the tank is at least 2 feet below the joint being repaired. Any paint damaged by repairs shall be properly restored.
- D. Upon completion of the sterilization procedure, the Owner or his representative shall arrange and bear the cost of any bacteriological testing of water samples from the tank that may be required. The tank shall not be placed in service until safe test results are obtained.

4.2 GUARANTEE

The Contractor shall guarantee its work for a period of one year from the date of substantial completion. Substantial completion is defined as the date when the tank is placed, or available to be placed, into service. The Contractor will repair any defects of which they are notified during that period which may appear because of faulty design, workmanship or materials furnished under the specifications. Defects caused by damaging service conditions such as electrolytic, chemical, abrasive or other damaging service conditions are not covered by this guarantee.

All guarantees obtained by the Contractor from the manufacturer or installer of paint, equipment or accessories not manufactured by the Contractor shall be obtained for the benefit of the Owner.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

specified in other sections	Piping Systems
40 05 06.16	Piping Connections
40 05 06.33	Piping Appurtenances
40 05 07	Hangers and Supports for Piping
40 05 19	Ductile Iron Pipe
40 05 61.16	Gate Valves
40 05 73.13	Altitude Valves

SECTION specified in
other sections PIPING
SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies systems of process piping and general requirements for piping systems. Detailed specifications for the components listed on the Piping System Specification Sheets are found in other sections of Division 40. This section shall be used in conjunction with those sections.

B. Definitions:

1. Pressure terms used in Section specified in other sections and elsewhere in Division 40 are defined as follows:
 - a. Maximum: The greatest continuous pressure at which the piping system operates.
 - b. Test: The hydrostatic pressure used to determine system acceptance.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AASHTO M36/M36M	Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts and Underdrains
ANSI A13.1	Scheme for the Identification of Piping Systems
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.3	Malleable Iron Threaded Fittings Class 150 and 300
ANSI B16.5	Pipe Flanges and Flanged Fittings

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

ANSI B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ANSI B16.11	Forged Steel Fittings, Socket Welding and Threaded
Reference	Title
ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312/A312M	Seamless and Welded Austenitic Stainless-Steel Pipe
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM B88	Seamless Copper Water Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C296	Asbestos-Cement Pressure Pipe
ASTM C443-REV A	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2996	Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4174	Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
Reference	Title

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

ANSI B16.12	Cast Iron Threaded Drainage Fittings
ANSI B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Qualifications
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A197	Cupola Malleable Iron
ASTM A234/A234M	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312/A312M	Seamless and Welded Austenitic Stainless-Steel Pipe
ASTM A403/A403M	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A536	Ductile Iron Castings
ASTM A570/A570M	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
ASTM B88	Seamless Copper Water Tube
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C296	Asbestos-Cement Pressure Pipe
ASTM C443-REV A	Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D1248	Polyethylene Plastics Molding and Extrusion Materials
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D2665	Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2996	Filament-Wound Reinforced Thermosetting Resin Pipe
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D4174	Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems
ASTM D4101	Propylene Plastic Injection and Extrusion Materials
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

Reference	Title
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe—4 In. and Larger—Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Services—Sizes 4 In. through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C301	Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids
AWWA C303	Reinforced Concrete Pressure Pipe—Steel Cylinder Type, Pretensioned, for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water
AWWA M11	Steel Pipe—A Guide for Design and Installation
CISPI 301	Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
FEDSPEC L-C-530B(1)	Coating, Pipe, Thermoplastic Resin or Thermosetting Epoxy
MIL-H-13528B	Hydrochloric Acid, Inhibited, Rust Removing
MIL-STD-810C	Environmental Test Methods
SAE J1227	Assessing Cleanliness of Hydraulic Fluid Power Components and Systems
UPC	Uniform Plumbing Code

B. Fittings and Coupling Compatibility:

1. To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

PART 2 PRODUCTS

2.01 PIPING MATERIALS

- A. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, linings and coatings, shall be selected from those listed on the piping system specification sheets. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in other sections of Division 40.

2.02 PIPING IDENTIFICATION

A. Plastic Coding Markers:

1. Plastic markers for coding pipe shall conform to ANSI A13.1 and shall be as manufactured by W. H. Brady Company, Seton Name Plate Corporation, Marking Services Inc., or Engineer and Owner approved equal. Markers shall be the mechanically attached type that are easily removable; they shall not be the adhesive applied type. Markers shall consist of pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe. Legend and backing shall be resistant

to petroleum-based oils and grease and shall meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C. Markers shall withstand a continuous operating temperature range of -40 degrees F to 180 degrees F. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.

2. Markers bearing the legends on the background colors specified in the PIPESPEC shall be provided in the following letter heights:

Outside Pipe Diameter, ¹ inches	Letter Height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1-1/8
Greater than 3	2-1/4

¹ Outside pipe diameter shall include insulation and jacketing.

3. In addition, pipe markers shall include uni- and bi-directional arrows in the same sizes as the legend. Legends and arrows shall be white on blue or red backgrounds and black on other specified backgrounds.

B. Plastic Tracer Tape:

1. Tracer tape shall be 6 inches wide, colored the same as the background colors as specified in Table A, paragraph 3.06, and made of inert plastic material suitable for direct burial. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or Engineer and Owner approved equal.
2. Two messages shall be printed on the tape. The first message shall read "CAUTION CAUTION PIPE BURIED BELOW" with bold letters approximately 2 inches high. The blank shall be filled with the particular system fluid such as Digester Gas. The second message shall read "CALL____" with letters approximately 3/4-inch high. Both messages shall be printed at maximum intervals of 2 feet.

2.03 VALVES

- A. Valves of the same size and service shall be provided by a single valve manufacturer. Packing shall be nonasbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length. Flanges shall meet the requirement of ANSI B16.5. Push-on and mechanical joints shall meet the requirements of AWWA C111. Valve operators are specified in Sections 40 05 57.13.

2.04 PRODUCT DATA

- A. Product data on piping materials shall be provided in accordance with Section 01 33 00 where specified.
- B. Piping layout drawings shall be transmitted to the Construction Manager a minimum of 2 weeks prior to construction. Drawings shall be original layouts by the Contractor; photocopies of contract drawings are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Location:

1. Piping shall be provided as specified except for adjustments to avoid architectural and structural features and shall be coordinated with electrical construction.

B. Piping Sizes:

1. Where the size of piping is not specified, the Contractor shall provide piping of the sizes required by PLUMBING SPECIALTY CODE. Unless specified otherwise, small piping (less than 1 inch in diameter) required for services not described by PLUMBING SPECIALTY CODE shall be 1/2 inch.

C. Pipe Support, Anchorage and Seismic Bracing:

1. General: Piping shall be supported by anchor brackets, guides, saddles or hangers. Acceptable types of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/contraction and for seismic bracing, as well as anchorage details, are shown on the drawings. Minimum spacing shall be as specified for supports and for seismic bracing. Where a specific type of support or anchorage is indicated on the drawings, then only that type shall be used there. Piping shall be vertically supported by anchor brackets, guides, saddles or hangers and shall be seismically braced where indicated to resist lateral load. Supports shall be provided on each run at each change of direction. Pipe supports shall be hot-dip or mechanically galvanized. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
2. Piping Connections to Machines: Piping at machine connections shall be aligned in all planes to permit insertion of bolts at bolted connections or coupling screwed connections without using jacks, come-a-longs or other mechanical means to align field piping with the connections at the machines. Bolts shall not be forced into mating flange bolt holes and shall be capable being withdrawn using finger pressure alone. The use of 'dutchmen' mitered sections or similar specials to achieve the required alignment with machine connections is strictly prohibited.

D. Anchorage for Buried Piping:

1. All plugs, caps, tees and bends in buried pressure piping systems shall be anchored by means of reaction backing or restrained joints as specified.

E. Bedding and Backfill:

1. Bedding and backfill for buried piping shall be as specified.

F. Equipment Connection Fittings

1. Where shown, equipment connection fittings as specified in Section 40 05 06.16 shall be provided between field piping systems and equipment inlet and outlet connections.

G. Flexibility

1. Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints as specified in Section 40 05 06.16.

3.02 PIPING IDENTIFICATION

A. Pipe Coding:

1. After application of the specified coating and insulation systems, exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers as specified in paragraph 2.02 Plastic Coding Markers. Legend markers and directional arrows shall be located at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50-foot centers.

B. Plastic Tracer Tape:

1. A single line of tape as specified in paragraph 2.02 Plastic Tracer Tape shall be provided 2.5 feet above the centerline of buried DG and CDS pipe. For DG and CDS pipelines buried 8 feet or greater below finished grade, contractor shall provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.

3.03 VALVE IDENTIFICATION

- A.** Stainless steel tags bearing the specified valve number stamped in 1/4-inch-high letters shall be installed on valve flanges in a position visible from floor level. Flangeless valves 8 inches in diameter and larger shall have tags attached to the valve body by self-tapping corrosion resistant metal screws. Flangeless valves 6 inches in diameter and smaller shall have tags attached to the valve stem by stainless steel wire. Wire shall be 0.063 inch minimum.

3.04 TESTING

A. General:

1. Upon completion of piping, but prior to application of insulation on exposed piping, the Contractor shall test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, the Contractor shall notify the Construction Manager 24 hours prior to each test.
2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.

B. Gas, Air, and Vapor Systems:

1. The Contractor shall test steam lines hydrostatically in accordance with the ASME procedure for testing pressure piping.
2. Unless otherwise specified, the testing medium for other gas, air and vapor systems shall be as follows:

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

Pipeline Size	Specified Test Pressure	Testing Medium
2 inch and smaller	75 psi or less	Air or water
2 inch and smaller	Greater than 75 psi	Water
Greater than 2 inch	3 psi or less	Air or water
Greater than 2 inch	Greater than 3 psi	Water

3. The allowable leakage rate for hazardous gas systems, insulated systems, and systems tested with water shall be zero at the specified test pressure throughout the specified test period. Hazardous gas systems shall include digester gas and natural gas systems.
 4. The allowable leakage rate for other systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, the air shall be at ambient temperature and specified test pressure.
- C. Liquid Systems:
1. Leakage shall be zero at the specified test pressure throughout the specified duration for the following systems: HWS and HWR exposed piping and buried insulated piping.
- D. Not used
- E. Not used
- F. Drains:
1. Drain systems, other than pumped drain systems, shall be tested in accordance with PLUMBING SPECIALTY CODE.

3.05 CLEANING AND FLUSHING

- A. General:
1. Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating or instrumentation equipment. The Contractor may, at his option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab.
- B. Temporary Screens:
1. Upon completion of the cleaning, the Contractor shall connect the piping systems to related process equipment. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

Equipment Suction or Piping Size, Inches	Maximum Screen Opening, Inches
0 - 1	1/16
1-1/4 - 3	1/4
3-1/2 - 6	1/2
Over 6	1

2. The Contractor shall maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. The Contractor shall remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempted.

C. Gas and Air Systems:

1. Unless otherwise specified, gas and air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6 inches shall be cleaned by having a swab or "pig" drawn through the separate reaches of pipe. After connection to the equipment, it shall then be blown out using the equipment. Upon completion of cleaning, the piping shall be drained and dried with an airstream. Sludge gas, natural gas and propane systems shall be purged with nitrogen and a nitrogen pad maintained at 10 psi until put in service.

D. Liquid Systems:

1. After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens.

E. Not used

F. Not used

G. Not used

H. Potable Water Systems:

1. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651.

3.06 PIPING SPECIFICATION SHEETS (PIPESPEC)

- A. Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets (PIPESPECS). Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services (PIPESPEC) is identified by a piping system number. Piping services specified in the PIPESPECS and on the drawings are alphabetically arranged by designated service symbols as shown in Table A. Table A also indicates the system number, fluid category, and pipe marker background color of each service.

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

Table A, Piping Services

Symbol	Service	System	Fluid category	Pipe marker background color / Letter Color
3W	Plant Effluent	11	Liquid	Match existing
DS	Digested Sludge	15	Sludge	Match existing

3.06 PIPING SPECIFICATION SHEET-PIPESPEC

Piping Symbol/Service: 3W—Plant Effluent System—11

Test Requirements:

Medium: Water; ref. spec paragraph 3.04 Liquid Systems.
Pressure: 200 psig
Duration: 120 minutes

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(2-inch and smaller)

Pipe: Steel; ASTM A53, galvanized. Ref. spec Specified in other sections.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

Valves: Ball; Jamesbury Fig. 351, Nibco T-580, or Engineer and Owner approved equal.

Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or Engineer and Owner approved equal. Swing check; Crane 137, Lunkenheimer 230, or Engineer and Owner approved equal.

(2 1/2-inch thru 8-inch)

Pipe: Steel; ASTM A53, ERW, Grade B, black, no lining. Ref. spec Specified in other sections.
Conn; butt weld, grooved mech pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel per spec Specified in other sections; ends to match pipe.

(2 1/2-inch thru 8-inch)

Valves: Butterfly; ref. spec Section 40 05 64. Substitute Type B on 2-1/2-inch lines.
Swing check; spring loaded per spec Specified in other sections.

(10-inch and larger)

Pipe: Steel; same as 8 inch or AWWA C200, 1/4 inch thick, w/lining. Ref. spec Specified in other sections.
Conn; butt weld, mech pipe coupling, or flanged. See Remarks.
Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.

Valves: Butterfly; ref. spec Section 40 05 64.
Swing check; spring loaded per spec Specified in other sections.

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Buried and Encased Pipe and Valves:

(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3-inch and smaller)

Pipe:

Steel; same as exposed with polyethylene tape coating. Field application of coating to all couplings. Ref. spec Specified in other sections.

Conn; taper threaded, ANSI B1.20.1 with coating. Flanged adapters for 2-1/2-inch, 3-inch valves.

Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized with coating.

Valves:

Gate; ref. spec Section 40 05 61.16, with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

(4-inch thru 12-inch)

Pipe:

Ductile iron; AWWA C151. Ref. spec Specified in other sections.

Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.

Ftgs; ductile iron per spec Specified in other sections; lining and ends to match pipe.

Valves:

Butterfly; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

(14-inch and larger)

Pipe:

Ductile iron; same as 12 inch for pipe and ftgs, or

Concrete cylinder; ref. spec Specified in other sections.

Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.

Ftgs; fabricated steel, mortar lined and coated. Ref. spec Specified in other sections.

Valves:

Butterfly; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in Specified in other sections.

EXIT 42 ELEVATED STORAGE TANK

JWSC Project No. 2213

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Piping Symbol/Service: DS – Digested Sludge System–15

Test Requirements:

Medium: Water; ref. spec paragraph 3.04 Liquid Systems.
 Pressure: 100 psig
 Duration: 120 minutes

Gasket Requirements:

Flange: Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder
 Push-on/Mech Cpl: Nitrile or Neoprene

Exposed Pipe and Valves:

(See drawings for pipe size and valve type)

(2-inch and smaller)

Pipe: Steel; ASTM A53, galvanized. Ref. spec Specified in other sections.
Conn; taper threaded, ANSI B1.20.1.
Ftgs; malleable iron, ASTM A197, ANSI B16.3, Class 150, galvanized.

Valves: Eccentric plug; per spec Specified in other sections. Install valve with seat upstream.
Swing check; Lunkenheimer 230, Crane 137, or Engineer and Owner approved equal.

(2 1/2-inch thru 8-inch)

Pipe: Steel; ASTM A53, ERW, Grade B, black, no lining. Ref. spec Specified in other sections.
Conn; butt weld, grooved mech pipe coupling or flanged.
Ftgs; malleable iron, ductile iron, or steel per spec Specified in other sections; ends to match pipe.

Valves: Eccentric plug; per spec Specified in other sections. Install valve with seat upstream.
Swing check; spring loaded per spec Specified in other sections.

(10-inch and larger)

Pipe: Steel; same as 8 inch or AWWA C200, 3/16 inch thick, with lining. Ref. spec Specified in other sections.
Conn; butt weld, mech pipe coupling, or flanged. See Remarks.
Ftgs; steel, ASTM A234, or fabricated steel, AWWA C208; lining and ends to match pipe.

Valves: Eccentric plug; ref. spec Specified in other sections.
Swing check; spring loaded per spec Specified in other sections.

3.06 PIPING SPECIFICATION SHEET—PIPESPEC

Buried and Encased Pipe and Valves:

(See drawings for pipe size and valve type. Omit coating on encased pipe.)

(3-inch and smaller)

Pipe:

PVC; ASTM D1784, Class 12454-B, ASTM D1785, Sch. 80. Ref. spec Specified in other sections. Provide magnetic tracer tape.
Conn; plain end; solvent weld with threaded or flanged adapters for valves.

Ftgs; PVC, Sch. 80, socket weld.

Valves:

Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

(4-inch thru 12-inch)

Pipe:

Ductile iron; AWWA C151. Ref. spec Section 40 05 19.

Conn; grooved end or restrained push-on rubber gasket joint. Flanged adapters for valves.

Ftgs; ductile iron per spec Section 40 05 19; coating, lining and ends to match pipe.

Valves:

Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

(14-inch and larger)

Pipe:

Ductile iron; same as 12 inch for pipe and ftgs or

Concrete cylinder; ref. spec Specified in other sections.

Conn; restrained bell and spigot with O-ring rubber gasket joint. Flanged adapters for valves.

Ftgs; fabricated steel, mortar lined and coated. Ref. spec Specified in other sections.

Valves:

Eccentric plug; same as exposed with extension stem and valve box. Coating M-1 per spec Section 09 90 00.

Remarks:

1. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in Specified in other sections.

END OF SECTION

SECTION 40 05 06.16
PIPING CONNECTIONS

PART 1 GENERAL

1.2 DESCRIPTION

- A. This section specifies the following methods of connecting metallic piping: flanges, threading, mechanical couplings, equipment connection fittings, dielectric unions, and welding.

1.3 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.1	Cast-iron Pipe Flanges and Flanged Fittings
ANSI B16.5	Pipe Flanges and Flanged Fittings
ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI B31.1	Power Piping
ANSI B31.3	Chemical Plant and Petroleum Refinery Piping
ASME Section IX	Boiler and Pressure Vessel Code; Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators Qualifications
ASTM B98	Copper-Silicon Alloy Rod, Bar and Shapes
ASTM F37	Standard Test Methods for Sealability of Gasket Materials
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F152	Standard Test Methods for Tension Testing of Nonmetallic Gasket Materials
ASTM F593	Stainless-steel Bolts, Hex Cap Screws, and Studs
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C206	Field Welding of Steel Water Pipe

Reference	Title
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. through 144 in.
AWWA C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
AWWA C550	Protective Epoxy Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe-A Guide for Design and Installation
NSF 61	Drinking Water System Components - Health Effects

1.4 SUBMITTALS

- A. In addition to the material listed in the detailed specification, the following submittals shall be provided in accordance with Section 01 33 00:
1. For Equipment Connection Fittings used in pumping applications submit thrust rod stretch calculations in accordance with paragraph 2.02 Equipment Connection Fittings. and dimensional layout data.

PART 2 PRODUCTS

2.1 FLANGE ASSEMBLIES

- A. Flanges:
1. General: Flanges shall either be flat flanges or convoluted ring flanges as specified in the following paragraphs.
 2. Flat Flanges: Cast-iron flanges shall be faced in accordance with ANSI B16.1. Where companion flanges are used, the flanges on pipe shall be refaced to be flush with the companion flange face. Class 150 and Class 300 forged steel flanges shall be raised face conforming to ANSI B16.5. Lightweight slip-on flanges shall be plain face conforming to AWWA C207, Class B and ANSI B16.5. Unless otherwise specified, steel flanges shall be ANSI B16.5, Class 150 or AWWA C207, Class D. Class E AWWA flanges shall be provided where test pressure exceeds 175 psi. Plain faced flanges shall not be bolted to raised face flanges.
 3. Convoluted Ring Flanges: Convoluted ring flanges shall be ductile iron, forged steel or cast stainless-steel, designed to bear on hubs welded to the pipe and shall be as manufactured by Improved Piping Products. The Engineer knows of no equal. The flange joints shall be rated for not less than 150 percent of the test pressures listed in Section specified in other sections and shall conform to the requirements of ANSI B 16.5 and AWWA C207. The flange manufacturer shall be prepared to demonstrate, by certified pressure test that the flanges will meet these requirements.
- B. Gaskets:
1. Gasket material shall be as specified in paragraph 2.03.
 2. Gaskets for plain faced flanges shall be the full-face type. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16 inch thick for pipe 3-1/2 inches and less in diameter and 1/8 inch thick for pipe 4 inches and larger.

C. Bolts:

1. Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.
2. Except where high strength bolts are specified in the PIPESPEC, flange bolts for exposed flanges shall be carbon steel machined bolts with hot pressed hexagon nuts, ASTM A307, Grade B8. Where high strength bolts are specified in the PIPESPEC, flange bolts for exposed flanges shall be carbon steel hex cap screws, ASTM A449, Type 1 or Type 3. All nuts and bolts for non-submerged service shall be hot-dip galvanized.
3. Bolts for submerged service shall be made of Type 316 stainless-steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be Type 316 stainless-steel conforming to ASTM F594, with a minimum proof stress equal to or greater than the tensile strength of the bolts. Assemble stainless-steel flange hardware using an anti-seize lubricant suitable for the installed conditions. Lubricant shall be Bostik Never Seez.
4. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

2.2 MECHANICAL COUPLINGS

A. Sleeve-Type Couplings:

1. Unless otherwise specified, sleeve-type mechanical pipe couplings shall be Smith-Blair Type 411, Dresser Style 38, or Engineer and Owner approved equal, with the stop removed from the middle ring. Reducing couplings shall be Smith-Blair Type 415, Dresser Style 62, or Engineer and Owner approved equal. Sleeve-type flanged coupling adapters shall be Smith-Blair Type 913, Dresser Style 128, or Engineer and Owner approved equal. Insulating couplings shall be Smith-Blair Type 416, Dresser Style 39, or Engineer and Owner approved equal.
2. Bolts for submerged service shall be made of Type 316 stainless-steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be made of copper-silicon alloy bronze conforming to ASTM B98, alloy C65100, designation H04, or alloy C65500, designation H04. Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.
3. Gaskets shall be as specified in paragraph 2.03 and AWWA C111.

B. Plain End Couplings:

1. Plain end pipe couplings for pipe sizes 6 inches and smaller shall be Gustin-Bacon 200, Victaulic Style 99, or Engineer and Owner approved equal for Schedule 80 pipe and Gustin-Bacon 205, Victaulic Style 90, or Engineer and Owner approved equal for lighter weight pipe. Plain end couplings for pipe sizes 8 inches and larger shall be Gustin-Bacon 200, Victaulic Style 99, or Engineer and Owner approved equal. Unless otherwise specified, bolts and nuts shall comply with AWWA C606.
2. Gaskets shall be as specified in paragraph 2.03 and AWWA C606.

C. Grooved End Couplings: (NOT USED)

D. Equipment Connection Fittings

1. Equipment connection fittings shall provide both lateral and angular misalignment adjustment between equipment connection flanges and the connection to field piping systems by providing individually adjustable flexible joints at each connection. In addition, equipment connection fittings shall provide full pressure thrust restraint between the field piping connection and equipment connection flanges.
2. Equipment connection fittings shall consist of two flanged coupling adapters, a plain end section of pipe and thrust restraint rods and associated fittings designed to transmit thrust without transmitting shear to the thrust restraint rods and without compromising provisions for accommodating angular and parallel misalignment. Materials and features shall conform to the requirements established in this paragraph. Standard "dismantling joints" incorporate only one flanged coupling adapter and are not acceptable substitutes. Equipment connection fittings shall be Romac ECF Series, or Baker Coupling Company, Los Angeles or Engineer and Owner approved equal, modified as specified to provide the required features.
3. Equipment connection fittings shall each consist of a single sleeve of plain end piping conforming to the requirements of the specified piping system of sufficient length to span the gap between the connection at the equipment and the connection at the field piping with gasketed flange adapters at each end. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and male rod nuts and female washers that are rounded to provide a ball-joint type self-aligning feature. All threaded restraint rod shall project through flange and mating flange coupling adapter bolt holes or through holes in restraint lug plates that extend above the flanges and are secured to the flanges with a minimum of two flange bolts. Where the all-threaded rods project through flange bolt holes, ball joint type nut and washer combinations and lock washers shall be provided at each face, each end. Where restraint lug plates are employed, ball joint type nuts and washers shall be provided only on the outside faces of the plates and the nuts shall have a self-locking feature that prevents nut movement due to vibration or other operational or environmental causes. Double nutting with non-locking nuts shall not be an acceptable method of providing the self-locking feature. Thrust rod diameter and material shall be selected to provide sufficient freedom of movement through all bolt holes to allow unrestricted maximum adjustment of equipment connection fittings to accommodate piping misalignment without transmitting any shear to the thrust rods and also to permit full development of thrust restraint at all thrust rod tension take-ups. Design of equipment connection fittings shall conform to AWWA C219.
4. Thrust rods, restraint lug plates, nuts, washers, and lock washers shall be Type 316 stainless-steel, all selected to develop full rated piping system pressure thrust forces. Equipment connection fittings for pump applications shall have thrust rod number and diameter selected such that thrust rod stretch under piping system operating pressure does not exceed 2 mils. Calculations shall be submitted. Dry film molybdenum di-sulfide anti-galling compound shall be factory applied to ends of thrust rods, covering all threads subject to nut travel and tightening. Gaskets shall be as specified in paragraph 2.03. Flange gaskets shall be full face type. Follower gaskets shall be compression wedge type.
5. Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316

stainless-steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61.

E. Dismantling Joints:

1. Dismantling joints may be used as takedown couplings in accordance with paragraph 3.03. Dismantling joints shall fully restrained double flange fittings consisting of a flange coupling adapter and flanged spool piece that allows for longitudinal adjustment. Thrust restraint shall be provided by means of all threaded rod spanning between flanges and secured to the flanges with a minimum of two flange bolts. Design of equipment connection fittings shall conform to AWWA C219. Sleeves shall be carbon steel or as specified for the specific piping system. Pressure rating of flange adapters shall equal or exceed the pressure rating of mating flanges. All metal portions of equipment connection fittings, with the exception of 316 stainless-steel components, shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. Dismantling joints shall be Romac DJ-400, Smith Blair 975, or Crane-Viking Johnson Dismantling Joint.

F. Sleeve Band Couplings: (NOT USED)

G. Flexijoint:

1. Where specified Flexijoint couplings shall be Romac FJ Restraint couplings. The Flexijoint is a flexible, ductile iron joint that can accommodate expansion, contraction, rotation and bending and is rated at 350 psi working pressure. The joint can accommodate 15-to-20-degree deflection depending on size. Body shall be ductile iron, lock rings Type 410 stainless-steel, and ring gasket, casing, ball and cover shall be EPDM molded watertight construction. All metal portions of Flexijoint coupling including the stainless-steel lock rings shall be coated and lined with fusion bonded epoxy conforming to AWWA C550 and NSF 61. For buried installations, install with polyethylene baggy cover in accordance with the manufacturer's instructions.

2.3 GASKETS

A. Gaskets designated shall be as follows:

1. EPDM: ethylene-propylene-diene-terpolymer.
2. Neoprene: neoprene.
3. Nitrile: nitrile (Buna N).
4. Compressed gasketing consisting of organic fibers (Kevlar) and neoprene binder; ASTM F104 (F712400), 2,500 psi (ASTM F152), 0.2 ml/hr Leakage Fuel A (ASTM F37).
5. Compressed gasketing consisting of organic fibers (Kevlar) and SBR binder; ASTM F104 (F712400), 2,500 psi (ASTM F152), 0.1 ml/hr leakage Fuel A (ASTM F37).
6. Gylon gasketing, Garlock Style 3500, 2,000 psi (ASTM F152), 0.22 ml/hr Fuel A (ASTM F37).
7. Gylon gasketing, Garlock Style 3510, 2,000 psi (ASTM F152), 0.04 ml/hr Fuel A (ASTM F37).
8. Gylon gasketing, Garlock Style 3504, 2,000 psi (ASTM F152), 0.12 ml/hr Fuel A (ASTM F37).
9. TFE: noncreeping tetrafluoroethylene (TFE) with insert filler.

10. PTFE bonded EPDM: PTFE bonded to EPDM in full-face gasket having concentric-convex molded rings; Garlock Stress Saver 370 or Engineer and Owner approved equal.

2.4 THREAD

- A. Pipe thread dimensions and size limits shall conform to ANSI B1.20.1.

2.5 DIELECTRIC UNIONS

- A. Dielectric unions shall be EPCO, Capitol Manufacturing, or Engineer and Owner approved equal.

2.6 PRODUCT DATA

- A. In accordance with Section 01 33 00, the Contractor shall provide for each welder, a welder qualification certificate indicating the welder is certified for pipe welding in accordance with ASME Boiler and Pressure Vessel, Section IX. Each welder's certificate shall be provided to the Engineer prior to that welder working on the job.

PART 3 EXECUTION

3.1 PIPE CUTTING, THREADING AND JOINTING

- A. Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1.

3.2 PIPE WELDING

- A. Pipe shall be welded by ASME-certified welders using shielded metal arc, gas shielded arc or submerged arc welding methods. Welds shall be made in accordance with the requirements of ANSI B31.1 for piping Systems 8, 26, and 28 specified in Section specified in other sections. Welds shall be made in accordance with the requirements of ANSI B31.3 for piping System 20 specified in Section specified in other sections.
- B. Welds for piping systems not specified above shall be made in accordance with AWWA C206.

3.3 TAKEDOWN COUPLINGS

- A. Takedown couplings shall be screw unions, flanged or grooved end mechanical coupling type joints and shall be provided as specified. Flanged or grooved end joints shall be employed on pipelines 2-1/2 inches in diameter and larger. Where piping passes through walls, takedown couplings shall be provided within 3 feet of the wall, unless specified otherwise.
- B. A union or flanged connection shall be provided within 2 feet of each threaded end valve.

3.4 FLEXIBILITY

- A. Unless otherwise specified, piping passing from concrete to earth shall be provided with two pipe couplings or flexible joints (or a single Flexijoint) as specified on the buried pipe within 2 feet of the structure for 2-inch through 6-inch diameter pipe; within 3 feet of the structure for 8-inch through 24-inch diameter pipe; and within one and one-half pipe diameters of the structure for larger pipe. Where required for resistance to pressure,

mechanical couplings shall be restrained in accordance with Chapter 13 of AWWA M11, including Tables 13-4, 13-5 and 13-5A, and Figure 13-20.

3.5 DIELECTRIC CONNECTIONS

- A. Where a copper pipe is connected to steel or cast-iron pipe, an insulating section of rubber or plastic pipe shall be provided. The insulating section shall have a minimum length of 12 pipe diameters. Dielectric unions as specified in paragraph 2.05 may be used instead of the specified insulating sections. Where copper pipe is supported from hangers, it shall be insulated from the hangers, or copper-plated hangers shall be used.

3.6 EQUIPMENT CONNECTION FITTINGS (NOT USED)

END OF SECTION

SECTION 40 05 06.33
PIPING APPURTENANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Scope: This Section specifies general connection information for pipeline instrumentation, strainers, sight glasses, vents, drains, and other devices.

1.2 QUALITY ASSURANCE

- A. Reference Standards: (NOT USED)

1.3 SUBMITTALS

- A. Procedures: Section 01 33 00.
- B. Action submittal items:
 - 1. Appurtenances shall be located on the piping layout drawings by plant area and submitted in accordance with Section specified in other sections (NOT USED).
 - 2. Manufacturer's product data, measurement ranges, materials of construction, dimensions, typical installation and application information.

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise specified:
 - 1. Body material of equipment shall match pipeline material.
 - 2. Pressure rating of equipment shall be no less than 150 psi.
- B. All units shall have the name of the manufacturer and the size of the unit cast on the body or shown on a permanently attached plate in raised letters.
- C. All equipment provided shall be equipped with flanges, integral unions, or other functional take-aparts.

2.2 PIPELINE CONNECTIONS

- A. General:
 - 1. Pipeline connections for instrumentation, not otherwise specified, shall be fabricated with a 3-inch FNPT branch outlet on the process pipe, a 3-inch male NPT by 3/4-inch female NPT reducing bushing, a 3/4-inch by 3-inch-long threaded nipple, and a threaded ball valve with lock open provisions.
 - 2. Materials and methods of connections, not otherwise specified, shall be the same as the process piping system per Section specified in other sections (NOT USED).
- B. Connection types:
 - 1. Connection types and details as specified and as shown in drawings.

2. Connection types shall protect the integrity of the process pipe and the lining and shall be, as a minimum:
 - a. Glass-lined ductile iron and steel pipe – factory installed threaded half-coupling, installed prior to lining, or tee with tapped blind flange or tap.
 - b. Unlined steel and stainless-steel pipe – reducing tee or threaded half coupling.
 - c. HDPE pipe – reducing tee or electro-fusion welded saddle by butt end.
 - d. PVC/CPVC pipe – solvent welded tee with branch socket adapted with solvent welded pipe or SCH 80 threaded fitting to suit use. Transition to metal pipe or fittings shall be PVC male NPT to threaded metal or flange by flange.

2.3 FLOW AND LEVEL INDICATORS (NOT USED)

2.4 STRAINERS (NOT USED)

2.5 QUICK CONNECT FITTINGS (NOT USED)

2.6 STATIC MIXERS (NOT USED)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install piping appurtenances in accordance with submitted layout drawings, applicable details and manufacturer's written recommendations.
- B. Repair linings damaged during installation. Damaged glass-lined pipe and/or fittings shall be replaced.
- C. Appurtenances shall be installed in such a manner as to be free of pipe strain in either the installed or operating conditions. Adjust pipe support systems, as required.

3.2 VENTS AND DRAINS (NOT USED)

END OF SECTION

SECTION 40 05 07
HANGERS AND SUPPORTS FOR PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. General: This section specifies hangers and supports for all exposed piping systems. This section does not include pipe supports for fire sprinkler systems or seismic restraints.
2. Scope of Contractor Design: The Contractor shall provide the services of a "Design Professional" to conduct all necessary piping and support design for exposed piping.
 - a. Whether a design or general arrangement is shown or not, Contractor's Design Professional shall design all pipe supports, anchorage, restraints and expansion control, as specified. Where a conflict arises, Contractor's Design Professional shall present any conflict to Construction Manager for resolution.
 - b. The Design Professional's work shall incorporate design criteria and other conditions as specified herein, in related sections and as shown on the drawings.
 - c. Additional requirements are specified in related sections.
3. Scope of Work by Design Engineer: Design Engineer has undertaken design details for supports and anchors for: selected discharge and intake manifolds; selected special installation requirements; and selected piping. Contractor's Design Professional shall incorporate these features into the Contractor's design.
 - a. Where shown, Design Engineer has also provided guidance in the form of general arrangements that may include specific types of supports or anchorage details. In addition, allowable anchor points and load capacities for potential support structures are shown or otherwise described herein.

B. Operating Conditions:

1. The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
 - a. Hot Systems
 - 1) A - 1. 120 degrees F to 450 degrees F
 - 2) A - 2. 451 degrees F to 750 degrees F
 - 3) A - 3. Over 750 degrees F
 - b. Ambient Systems
 - 1) B. 60 degrees F to 119 degrees F
 - c. Cold Systems
 - 1) C - 1. 33 degrees F to 59 degrees F
 - 2) C - 2. -20 degrees F to 32 degrees F

C. Hanger and Support Selection:

1. The Contractor shall cause the pipe hangers and supports to be designed and selected by the Design Professional. This provision, however, shall not relieve the Contractor of overall responsibility for this portion of the work. Hanger and support selection shall be based on the following:
 - a. The Contractor shall select pipe hangers and supports as specified in the project manual. Selections shall be based upon the pipe support classifications specified in MSS-SP 69 and any special requirements which may be specified in the project manual.
 - b. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
 - c. Where a particular pipe support arrangement is shown, a design incorporating that arrangement shall be used.
 - d. Where a particular pipe support design is shown that design shall be used.
 - e. Pipe supports shall be spaced such that pipe span deflections do not exceed 0.1-inch.
 - f. Pipe support design shall incorporate applicable criteria of ASME or other recognized standard.
 - g. The pipe hanger and support system shall be coordinated with the seismic restraint system.
 - h. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:
 - 1) Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
 - 2) Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
 - 3) Reaction forces due to test and operational conditions.
 - 4) Reaction forces due to the operation of safety, relief, or other valves.
 - 5) Wind, snow or ice loadings on outdoor piping.
 - 6) Supports shall be designed to prevent transfer of the weight of piping, valves and piping appurtenances to equipment piping connections. All supports adjacent at equipment connections to piping systems shall have provisions for vertical and horizontal adjustment. Two flexible piping connections not less than one pipe diameter apart shall be provided between piping supports and any equipment piping connection.
 - i. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.
 - j. Where negligible movement occurs at hanger locations, rod hangers shall be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members shall be used.
 - k. Hangers for the suspension of size 2 1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.
 - l. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.

- m. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
 - n. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless-steel hanger and support components.
 - o. Stock hanger and support components shall be used wherever practical.
 - p. Fiberglass framing channel shall be provided where specified.
- D. The following structural criteria shall also be applied:
 - 1. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
 - 2. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
 - 3. Where critical support load requirements have been identified, limiting structural load requirements are shown.
 - 4. Pipe support hangers, brackets etc. shall be of suitable capacity and shall be appropriate to the individual structural member that is used to support the pipe.
 - 5. The structural integrity of existing and new members shall in no way be impacted by the placement of connections for pipe supports. For example, the tension reinforcement in reinforced concrete members shall not be impacted in any way by the placement of fasteners for pipe supports.
 - 6. Spacing and arrangement of hangers supporting pipe shall be provided in such a manner that the loads from the pipes on existing and new structural members shall be quasi-uniform. These quasi-uniform loads shall not exceed the allowable design loads for mechanical equipment as shown on existing (not necessarily contract) drawings and as listed under Design Live Loads in the General Notes.
 - 7. For new construction, unless otherwise shown, pipe may be supported from nearest structural element (floor, ceiling, or wall). The Design Loads for mechanical equipment, as listed in the General Notes sheet of the Structural drawings shall not be exceeded.
 - 8. The loads and specific attachment requirements for pipe supports on new concrete Tees shall be coordinated with the Tee manufacturer and incorporated into the design of the Tees.
 - 9. Unless otherwise specified, pipe supports from existing Tees or other roof types shall not be constructed without an evaluation of capacity and appropriate design from Contractor's Design Professional.
- E. The following, project-specific criterion shall also be applied:
 - 1. The spacing for pipe hangers shall not be less than 5 feet and shall not exceed 375 lb of load for all existing pre-cast, Double Tee roof elements. For hangers off flanges of existing Tees, a washer shall be provided having minimum dimensions of 1/4 inch thick by 4 inch long and 4 inch wide. The design and projection of those hangers above the roof shall be coordinated with the architectural roofing system.
 - 2. For sodium hydroxide systems, pipe supports shall be 60 percent closer than the maximum spacing indicated for plastic piping for water service.

1.2 QUALITY ASSURANCE

A. References

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design - 9th Ed.
FEDSPEC WW-H-171e-78	Hangers and Supports, Pipe
MFMA-2-91	Metal Framing Standards Publication
MSS SP-69-91	Pipe Hangers and Supports - Selection and Application
MSS SP-58-93	Pipe Hangers and Supports - Materials, Design and Manufacture

B. Design:

1. The Contractor shall cause the design of pipe hanger and support systems to be developed in conjunction with preparation of the design seismic restraints and expansion control system by the Design Professional selected in accordance with Section 40 05 07-1.01 Scope.
2. The pipe system drawings specified in Section 40 05 07-2.04 shall show the hanger and support locations as well as the details of the seismic restraints and expansion control systems. The pipe hanger and support design drawings and calculations shall be prepared and signed by the design professional and shall bear the Design Professional's registration seal.

PART 2 PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, or Engineer and Owner approved equal. Pipe support components shall conform to the requirements of MSS SP-69 and FEDSPEC WW-H-171e. Pipe support materials shall conform to the requirements of MSS SP-58. Metal framing system components shall conform to the metal framing manufacturers' Association Standard MFMA-2.

2.2 MATERIALS

A. General:

1. Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories shall be hot-dip or mechanically galvanized after fabrication. Nuts, bolts and washers may be zinc-plated except for those subject to moisture or corrosive atmosphere, as specified or as shown on the drawings, which shall be type FRP or 316 stainless-steel.

B. Pipe Hangers and Supports:

1. Pipe hangers and supports of dissimilar metals than pipe shall be insulated. Pipe hangers and supports shall support pipe in the manner recommended by the pipe manufacturer and/or applicable building or piping codes.

C. Rack and Trapeze Supports:

1. Unless otherwise specified, trapeze and pipe rack components shall have a minimum steel thickness of 12 gage, with a maximum deflection 1/240 of the span.

D. Structural Attachments:

1. Type A - Malleable Iron Concrete Insert: Concrete inserts shall be malleable iron and comply with MSS and FEDSPEC Type 18. Grinnell Fig. 282, Carpenter & Patterson Fig. 108, or Engineer and Owner approved equal.
2. Type B - Side Beam Bracket: Bracket shall be malleable iron and comply with MSS Type 34 and FEDSPEC Type 35. Grinnell Fig. 202, B-Line B3062, or Engineer and Owner approved equal.
3. Type C - Malleable Beam Clamp with Extension Piece: Clamp and extension piece shall be malleable iron, tie rod shall be steel. Beam clamp shall comply with MSS and FEDSPEC Type 30. Grinnell Fig. 218 with Fig. 157 extension piece, B-Line B3054, or Engineer and Owner approved equal.
4. Type D - Steel Beam Clamp With Eye Nut: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or Engineer and Owner approved equal.
5. Type E - Framing Channel Post Base: Post bases shall be carbon steel, of standard design manufactured by framing channel manufacturer. Single channel: Unistrut P2072A, B-Line B280, or Engineer and Owner approved equal. Double channel: Unistrut P2073A, B-Line B281, or Engineer and Owner approved equal.
6. Type F - Welded Beam Attachment: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or Engineer and Owner approved equal.
7. Type G - Welded Steel Bracket: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket. Heavy welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.
8. Type H - Cast-iron Bracket: Bracket shall be cast-iron, Carpenter & Patterson Fig. 340, or Engineer and Owner approved equal.
9. Type J - Adjustable Beam Attachment: Beam attachment shall be carbon steel, Carpenter & Patterson Fig. 151, B-Line B3082, or Engineer and Owner approved equal.
10. Type K - Double Channel Bracket: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel. Cantilever bracket shall be

a carbon steel double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or Engineer and Owner approved equal.

11. Type L - Single Channel Bracket: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel. Cantilever bracket shall be a carbon steel single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or Engineer and Owner approved equal.
12. Type M - Wall Mounted Channel: Wall channel shall be single channel framing channel as specified in paragraph 2.02 Framing Channel.
13. Type N - Pipe Stanchion Floor Attachment: Baseplate shall be carbon steel with 1/2 inch minimum thickness. Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with nonshrink grout.
14. Type Q - Continuous Concrete Inserts: shall be 1 5/8 by 1 3/8 Channel, cold formed 12 Ga. steel conforming to ASTM A 1001, stainless-steel GR 33 or ASTM GR 33 A., hot dip galvanized conforming to ASTM A123 or A153, UNISTRUT P3200 Series, or Engineer or Owner approved equal.

E. Accessories:

1. Hanger Rods: Rods shall be carbon steel, threaded on both ends or continuous threaded and sized as specified.
2. Weldless Eye Nut: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B3200, or Engineer and Owner approved equal.
3. Welded Eye Rod: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B3211, or Engineer and Owner approved equal.
4. Turnbuckle: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 13. Turnbuckle shall be Grinnell Fig. 230, B-Line B3202, or Engineer and Owner approved equal.
5. Framing Channel: Framing channel shall be 1 5/8 inches square, roll formed, 12-gage carbon steel. Channel shall have a continuous slot along one side with in-turned clamping ridges. Single channel: Unistrut P1000, B-Line B22, or Engineer and Owner approved equal. Double channel: Unistrut P1001, B-Line B22A, or Engineer and Owner approved equal. Triple channel: Unistrut P1004A, B-Line B22X, or Engineer and Owner approved equal.

2.3 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01 33 00:
1. Hanger and support locations and components shall be indicated on the piping layout drawings.
 2. Design Professional's reports as specified in paragraph 3.5.

PART 3 EXECUTION

2.4 HANGER AND SUPPORT LOCATIONS

- A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project manual to support continuous pipeline

runs unaffected by concentrated loads.

- B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.
- C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- D. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
- E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.2 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of the AISC Manual of Steel Construction. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Hanger components shall not be used for purposes other than for which they were designed. They shall not be used for rigging and erection purposes.
- C. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- D. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.
- E. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- F. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.
- G. Rollers shall roll freely without binding.
- H. Finished floor beneath Type N structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
- I. Baseplates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- J. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.

3.3 ADJUSTMENTS

- A. The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be

used. Stanchions shall be adjusted prior to grouting their baseplates.

3.4 ANCHOR BOLTS

A. Anchor bolts in new concrete shall be cast in place. Refer to Section 05 05 20.

3.5 INSPECTION AND CERTIFICATION

The design professional retained by the Contractor shall inspect the pipe hangers, support and restraint systems at not less than bi-weekly intervals during construction and furnish the Construction Manager with monthly reports at no additional cost to the Owner. The Design Professional shall inspect the completed pipe hanger, support and restraint system before the Owner assumes beneficial occupancy and provide written certification, without any qualification statements, that the installation conforms to the design professional's design and the Contract Document requirements as may be described in other Sections or on the drawings. All reports shall bear the Design Professional's seal and signature in accordance with the laws, rules and regulations of the state.

TABLE A - SUPPORT SPACING AND ALLOWABLE ROD LOADS						
NOMINAL PIPE SIZE (INCHES)	SUPPORT ROD SIZE AND MAXIMUM LOAD PER ROD - SEE NOTES 1 AND 2		MAXIMUM SUPPORT SPACING (FEET)			
	ROD SIZE (INCHES)	MAX LOAD (POUNDS)	STEEL	COPPER	PLASTIC SEE NOTE 4	CAST IRON SEE NOTE 5
3/8 TO 3/4	3/8	610	5	5	CONTINUOUS	---
1	3/8	610	5	5	5	---
1-1/4	3/8	610	5	5	5	---
1-1/2	3/8	610	5	5	5	---
2	3/8	610	10	5	5	12 FEET FOR PRESSURE PIPE 10 FEET FOR SOIL PIPE
2-1/2	3/8	610	10	10	5	
3	3/8	610	10	20	5	
4	1/2	1130	10	20	5	
6	5/8	1810	15	20	5	
8	3/4	2710	15	20	5	
10	3/4	2710	20	---	5	
12	1	4960	20	---	10	
14	1	4960	20	---	---	
16	1	4960	20	---	---	
18	1	4960	20	---	---	
20	1-1/4	8000	20	---	---	
24	1-1/4	8000	20	---	---	
30	1-1/2	11630	20	---	---	

TABLE A NOTES:

- DESIGN WEIGHT SHALL BE TWICE THE WEIGHT OF THE PIPE FULL OF WATER PLUS THE WEIGHTS OF VALVES, FITTINGS, INSULATING MATERIALS AND SUSPENDED HANGER COMPONENTS ON THE RUN OF PIPE BEING SUPPORTED.
- ROD SIZES SHOWN ARE FOR THE SUPPORT OF A SINGLE PIPE. WHEN SUPPORTING MORE THAN ONE PIPE, ROD SHALL BE SIZED USING DESIGN WEIGHTS (SEE NOTE 1) TO DETERMINE THE TOTAL DESIGN LOAD. THE TOTAL DESIGN LOAD SHALL NOT EXCEED THE MAXIMUM LOADS IN THE TABLE ABOVE.
- PIPE SHALL NOT HAVE POCKETS FORMED IN THE SPAN DUE TO SAGGING OF THE PIPE BETWEEN SUPPORTS CAUSED BY THE WEIGHT OF THE PIPE, MEDIUM IN THE PIPE, INSULATION, VALVES AND FITTINGS.
- SPAN SHOWN IS FOR SCHEDULE 80 PVC PIPE AT 100°F. SPANS FOR OTHER PLASTICS, OTHER PVC PIPE SCHEDULES AND PIPES AT HIGHER TEMPERATURES SHALL BE SHORTENED IN ACCORDANCE WITH THE PIPE MANUFACTURER'S RECOMMENDATIONS. "CONTINUOUS" MEANS PIPE SHALL BE IN UNISTRUT OR SIMILAR CHANNEL.
- PROVIDE A MINIMUM OF ONE HANGER PER PIPE LENGTH, WITHIN 4-INCHES OF THE BELL.
- PIPE HANGER AND SUPPORT SELECTION SHALL BE IN ACCORDANCE WITH TABLE B (M2302) AND SPECIFICATION SECTION 15096.

EXIT 42 ELEVATED STORAGE TANK
JWSC Project No. 2213

TABLE B HANGER AND SUPPORT SELECTIONS														
SYSTEM TEMP RANGE DEG F	INSULATION NOTE 1	PIPE ATTACHMENTS									BUILDING STRUCTURAL ATTACHMENTS			
		HORIZONTAL								VERTICAL	STEEL AND/OR MALL. IRON			
		STEEL STRAPS	STEEL BANDS	STEEL CLAMPS	CAST IRON HANGING ROLLS	CAST IRON SUPPORTING ROLLS	STEEL TRAPEZES AND RACKS	THERMAL HANGER SHIELDS	STEEL OR CAST IRON STANCHIONS	STEEL RISER CLAMPS	INSERTS	BEAM CLAMPS	WELDED AND BOLTED ATTACHMENTS	BRACKETS
HOT A-1 120 TO 450	COVERED	13	1,2	3	4, 5	8	20,21	SEE SPEC	10	11, 12	A	C,D	F,J,M	B,G,H, K,L
	BARE	6, 7 13	1,2	3	4, 5	8	20,21	NONE	10					
HOT A-2 451 TO 750	COVERED	13	1	3	4, 5	8	20,21	SEE SPEC	10	11, 12	A	C,D	F,J,M	B,G,H, K,L
	BARE	NONE	NONE	3	NONE	NONE	20,21	NONE	NONE					
HOT A-3 OVER 750	COVERED	13	1	3 (ALLOY)	4, 5	8	20,21	SEE SPEC	10	11, 12	NONE	C,D	F,J,M	B,G,H, K,L
	BARE	13	NONE	3 (ALLOY)	NONE	NONE	20,21	NONE	NONE					
AMBIENT B 60 TO 119	COVERED	13	1,2	3	4, 5	8	20,21	SEE SPEC	9,10	11, 12	A	C,D	F,J,M	B,G,H, K,L
	BARE	6, 7 13	1,2	3	4, 5	8	20,21	NONE	9,10					
COLD C-1 33 TO 59	COVERED	13	1,2,3	3	4,5	8	20,21	SEE SPEC	10	11, 12	A	C,D	F,J,M	B,G,H, K,L
	BARE	6, 7 13	1,2,3	3	4, 5	8	20,21	NONE	10					
COLD C-2 -2 TO 32	COVERED	13	1,2,3	3	4, 5	8	20,21	SEE SPEC	10	11, 12	A	C,D	F,J,M	B,G,H, K,L
	BARE	NONE	1,2,3	3	4, 5	8	20,21	NONE	10					

TABLE B NOTES:

- HANGERS ON INSULATED SYSTEMS SHALL INCORPORATE THERMAL HANGER SHIELDS.
- HANGER AND SUPPORT SPACING SHALL BE INACCORDANCE WITH TABLE A (M2301).

TABLE C
SEISMIC RESTRAINT SPACING

NOM. PIPE SIZE	MAXIMUM SPAN BETWEEN BRACES		BRACE TYPE	MAXIMUM BRACE LENGTH
	LATERAL BRACE (FEET)	LONGITUDINAL BRACE (FEET)		
2	40	80	A1	9'-4"
2-1/2	40	80	A1	9'-4"
3	40	80	A1	9'-4"
4	40	80	A1	9'-4"
6	40	80	A1	9'-4"
8	40	40	A1	9'-4"
10	40	40	A1	9'-4"
12	40	40	A2	10'-0"
14	30	30	A2	10'-0"
16	25	25	A2	10'-0"
18	20	20	A2	10'-0"
20	16	16	A2	10'-0"
24	10	10	A2	10'-0"

(S) - STANDARD WALL

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies ductile iron pipe, ductile fittings, and gaskets.

B. Definition:

1. Where cast-iron pipe is specified, the term and symbol shall mean ductile iron pipe.

1.2 REFERENCES

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A21.14	Ductile-Iron Fittings 3 In. Through 24 In., for Gas
ANSI A21.52	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for Gas
ANSI B16.1	Cast-iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A716	Ductile-Iron Culvert Pipe
ASTM C150	Portland Cement
AWWA C104 (ANSI A21.4)	Cement-Mortar Lining for Ductile- Iron and Gray-Iron Pipe and Fittings for Water
AWWA C110 (ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111 (ANSI A21.11)	Rubber-Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115 (ANSI A21.15)	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C116 (ANSI A21.16-09)	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C150 (ANSI A21.50)	Thickness Design of Ductile-Iron Pipe

Reference	Title
AWWA C151 (ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153 (ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 12 In. for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints

1.3 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks shall denote full compliance with a paragraph as a whole.
 2. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation.
 3. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
 4. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 PRODUCTS

2.1 GENERAL

- A. Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150
Manufacturing requirements	
• Water or other liquid	AWWA C151
• Gas	ANSI A21.52
Gravity service pipe	ASTM A716
Joints	
• Rubber gasket	AWWA C111
• Threaded flange	AWWA C115
Fittings	
• Water or other liquid	AWWA C110/AWWA C153
• Gas	ANSI A21.14
Cement mortar lining	AWWA C104

2.2 PIPE

- A. Unless otherwise specified, ductile iron pipe shall be supplied as follows:

Diameter	Minimum Pressure Class
4-inch through 14-inch	350
16-inch and greater	250

- B. Unless otherwise specified, pipe shall have nominal laying lengths of 18 or 20 feet.
- C. All pipe shall be manufactured in the United States of America.

2.3 GASKETS

- A. Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50 percent by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

2.4 FITTINGS

- A. Unless otherwise specified, fittings shall conform to AWWA C110. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified. The AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings unless otherwise specified. Long-radius elbows shall be provided where specified. To assure uniformity and compatibility of piping components, fittings and couplings for grooved end piping systems shall be furnished by the same manufacturers.

2.5 JOINTS

- A. Unrestrained Joints:

1. Push-On Joints: Unrestrained joints, where specified, shall be the rubber ring compression, push-on type joint suitable for buried service. Unrestrained joints shall be the Fastite Joint as manufactured by American Cast-iron Pipe Company, the Tyton Joint as manufactured by U.S. Pipe, or Engineer and Owner approved equal. This joint is not permitted on fittings or specials, unless otherwise specified. Unless otherwise specified, joints shall have an allowable deflection up to 5 degrees at specified pressures. Joint assembly and field cut joints shall be made in strict conformance with AWWA C600 and manufacturer's recommendations.
2. Mechanical Joints: Where specified, mechanical joints for above or below ground service shall meet the requirements of ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.11/C111. Gaskets and bolts and nuts shall comply with paragraphs 2.03 and 2.05 Bolts and Nuts, respectively.

- B. Restrained Joints:

1. General: Unless otherwise specified, restrained joints are required for all exposed and buried piping. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and restrained push-on for buried service.

2. Push-On Joints:
 - a. Restrained push-on joints shall be as specified in paragraph 2.05 Push-On Joints, modified for restraint.
 - b. Joints shall be the Flex-Ring or Lok-Ring Joint as manufactured by American Cast-iron Pipe Company, TR Flex Joint as manufactured by US Pipe, or Engineer and Owner approved equal. Restrained joints shall be capable of being deflected after full assembly.
 - c. For buried straight runs of pipe 16-inch and smaller (or where specifically noted on the drawings), American Cast-iron Pipe "Fast Grip", U.S. Pipe "Field-Lok" or Engineer and Owner approved equal shall be allowed for restraint.
 - d. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations.
 - e. No field cuts of restrained pipe are permitted without prior approval of the Engineer.
3. Mechanical Joints:
 - a. Where specified, restrained mechanical joints shall be the positive restraint type.
 - b. Mechanical joints with retainer glands are acceptable for buried fittings and valves.
 - c. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.
4. Flange Assemblies: Unless otherwise specified, flanges shall be ductile iron and shall be threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110. Flanges shall be adequate for 250 psi working pressure. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges. Where specified, flanges shall be threaded-on or cast-on flanges conforming to ANSI B16.1, Class 250.
 - a. Bolts:
 - 1) Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head bolts with ANSI B18.2.2 standard hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5.
 - 2) Except where high strength bolts are specified, flange bolts for exposed flanges shall be carbon steel machined bolts with hot pressed hexagon nuts, ASTM A307, Grade B8. Where high strength bolts are specified in the PIPESPEC, flange bolts for exposed flanges shall be carbon steel hex cap screws, ASTM A449, Type 1 or Type 3. All nuts and bolts for non-submerged service shall be hot-dip galvanized.
 - 3) Bolts for submerged service shall be made of Type 316 stainless-steel in conformance with ASTM F593, marking F593F. Nuts for submerged service shall be Type 316 stainless-steel conforming to ASTM F594, with a minimum proof stress equal to or greater than the tensile strength of the bolts. Assemble stainless-steel flange hardware using an anti-seize lubricant suitable for the installed conditions. Lubricant shall be Bostik Never Seez.
 - 4) Bolts and nuts for buried service shall be made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating. Where washers are required, they shall be of the same material as the associated bolts.

- b. Gaskets:
 - 1) Gasket material shall be as specified in paragraph 2.03.
 - 2) Gaskets for plain faced flanges shall be the full-face type. Thickness shall be 1/16 inch for pipe 10 inches and less in diameter and 1/8 inch for pipe 12 inches and larger in diameter. Unless otherwise specified, gaskets for raised face flanges shall match the raised face and shall be 1/16 inch thick for pipe 3-1/2 inches and less in diameter and 1/8 inch thick for pipe 4 inches and larger.
- 5. Thrust Restraint
 - a. Two forms of thrust restraint shall be installed at all hydrants, valves, plugs, caps, tees, bends deflecting 11 ¼ degrees or more and other fittings.
 - b. Thrust restraints at hydrants and valves shall be accomplished by installing eyebolts on the hydrant or valve and tying to an adjacent fitting or concrete tie-back using the appropriate quantity and size of treaded rods per drawings (Deadman for Plug Detail indicates rod size and quantity per pipe size). Thrust restraint shall also include one of the following:
 - 1) Restrained joint pipe and fittings
 - 2) Mega-Lugs or Engineer and Owner approved equal.
 - c. Thrust restraint at plugs, caps, tees, bends deflecting 11 ¼ degrees or more and other fittings shall be accomplished by cast-in place concrete blocking installed to dimensions as shown on thrust block details (see drawings) and shall be placed against undisturbed soil. Thrust restraint shall also include one of the following:
 - 1) Restrained joint pipe and fittings
 - 2) Mega-Lugs or Engineer and Owner approved equal
- C. Ball and Socket Flexible Joint Pipe:
 - 1. Ball and socket flexible joint pipe shall be the boltless type and shall allow a maximum joint deflection of 15 degrees. Each joint shall be provided with a retainer lock to prevent rotation after assembly. Joints shall be the Flex-Lok Joint as manufactured by American Cast-iron Pipe Company, USIflex as manufactured by U.S. Pipe, or Engineer and Owner approved equal.
- D. Bolts and Nuts:
 - 1. Corrosion-resistant bolts and nuts for use with ductile iron joints shall be Type 316 stainless-steel."

2.6 PIPE COATING

- A. Pipe and fittings shall be furnished with a metallic zinc coating (mass of 200 g/m²) applied directly to the pipe, as specified in ISO 8179.
- B. Additionally, pipe and fittings shall be coated with asphaltic material as specified in AWWA C151.
- C. Where within 20 linear feet of an existing steel gas line, or corrosive soils or soils with electrical currents are encountered that may, or in the judgment of the Owner, cause a deleterious effect on the piping system shall be wrapped with 8-mil polyethylene sleeves in accordance with the manufactures recommendations to a minimum distance of 20

lineal feet beyond such conditions. All elements of the piping system shall be wrapped entirely in polyethylene tubing and secured with polyethylene tape to completely prevent the entrance of foreign matter. Such encasement shall be carried out in accordance with ANSI/AWWA C105/A21.5.

2.7 PIPE LINING

A. Cement Mortar Lining:

1. Pipe:
 - a. Cement mortar lining shall be to Standard thickness in accordance with ANSI/AWWA C104/A21.4.
2. Fittings:
 - a. Cement mortar lining shall be to Double thickness in accordance with ANSI/AWWA C104/A21.4.

2.8 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 00:

1. Shop drawings.
2. Alignment drawings.
3. Certifications specified in the following documents:
 - a. ANSI A21.14, paragraph 14-4.2
 - b. ANSI A21.52, paragraph 52-4.2
 - c. ASTM A716, paragraph 4.2
 - d. AWWA C110, paragraph 10-5.3
 - e. AWWA C111, paragraph 11-7.1
 - f. AWWA C115, paragraph 15-4.2
 - g. AWWA C151, paragraph 51-5.2
 - h. AWWA C153, paragraph 53-6.3
 - i. AWWA C606, paragraph 4.1.1.1

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Piping runs specified on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01 33 00.
2. Pipe shall be installed in accordance with AWWA C600.
3. Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work, cutting and shaping. Concrete mortar shaping within any structure and manhole shall be as specified.
4. Coatings and linings shall be inspected for damage during installation, and damage shall be repaired according to the coating manufacturer's recommendations.

B. Unloading and Laying

1. Unload ductile iron pipe, fittings and accessories with hoists or by skidding. Under no circumstances are pipe to be dropped. Do not skid or roll pipe handled on skid ways against pipe already on the ground. Do not damage casting and linings; but, in the event should damage occur, make repairs or replacement to satisfaction of the Engineer/Inspector.
2. Use proper, suitable tools and appliances for the safe and convenient handling and laying of the pipe and fittings. Take care to prevent the pipe coating from being damaged, particularly on the inside of the pipe and fittings.
3. Pipe may not be "strung" along the job within highway right-of- ways without the approval of the Engineer/Inspector.
4. Carefully examine all pipe and fittings for defects just before laying and lay no pipe or fitting which is known to be defective. In the event that defective pipe is discovered after having been laid, remove and replace with a sound pipe or fitting in a satisfactory manner at Contractor's expense.
5. Thoroughly clean all pipe and fittings before being laid. Plug open ends of pipe with an approved plug during construction.

C. Insulating Sections:

1. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section of rubber or plastic pipe shall be provided. The insulating section shall have a minimum length of 12 pipe diameters. Dielectric unions as specified below may be used instead of the specified insulating sections. Where copper pipe is supported from hangers, it shall be insulated from the hangers, or copper-plated hangers shall be used. Dielectric unions shall be EPCO, Capitol Manufacturing, or Engineer and Owner approved equal.

D. Anchorage:

1. Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01 33 00.

3.2 ACCEPTANCE TESTING

- A. Hydrostatic pressure tests shall be conducted in accordance with Section 4 of AWWA C600 except as listed below.
- B. After the pipe is laid each section of water main as may be determined, or defined by the Owner, shall be properly and adequately flushed all air removed and then tested under a hydrostatic pressure of 150 psi, as measured at the lowest part on the test section. Where static pressure exceeds 100 psi, the test pressure as measured at the lowest part on the test section shall be equal to the static pressure plus 50 psi. If elevation differentials, within a test section, vary by more than 45 feet then the section shall be broken into a shorter length by the insertion of additional valves.
- C. The Contractor shall conduct the tests in the presence of the Engineer.
- D. To facilitate the testing, the Contractor shall furnish: 1) a pressure gauge for measuring the pressure on the water main; 2) a corporation cock in the main to attached gauge or pump connection; 3) plugs to seal taps after use in testing; 4) a suitable pump, pipe, and appliances, labor, fuel, and other appurtenances necessary to make these tests; 5) a

- valve wrench and labor to accompany the Owner Project Inspector to verify that all valves, including fire hydrant branch valves, are fully open during the pressure test.
- E. NOTE: The use of fire hydrants as connection points for either hydrostatic testing or injection of chlorine solutions for disinfection is expressly prohibited.
 - F. Each section of pipe shall be filled slowly with water and the specified test pressure, as noted above, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The Owner will furnish all water necessary for flushing and testing of water mains. The Contractor shall provide whatever means necessary for transporting or conveying the water to the test section.
 - G. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, as directed by the Owner Project Inspector, if necessary, at points of highest elevation, and afterward tightly plugged, all at the Contractor's expense.
 - H. The test pressure shall not vary by more than ± 5 psi for a minimum of two (2) hours to allow for thorough examination of leakage where necessary and allow the Owner Project Inspector to confirm that all the air has been removed, and that all valves within the test section are fully open. The pipe line shall be made watertight under the test pressure.
 - I. A Testing Allowance in compliance with AWWA C600, Section 5.2 and Table 6 shall be applied. The Testing Allowance shall be defined as the quantity of makeup water that must be supplied to the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. No pipe installation will be accepted if the amount of makeup water is greater than that allowed by AWWA C600.
 - J. Any exceeding of the testing allowance or leakage developed during the test shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility meeting the testing requirements specified herein.

3.3 CLEANING AND FLUSHING

- A. Before being placed in service, all new water main pipe lines and accessories shall be chlorinated. Chlorinating equipment and materials, labor and supplies shall be furnished by the Contractor.
- B. Prior to chlorination, mud, dirt, debris and other foreign matter shall be removed by a thorough flushing through the hydrants or by other approved means. Each valved section of newly laid pipe shall be flushed independently. That shall be done prior to the pressure test to ensure removal of any trapped air within the pipe.
- C. A chlorine gas/water mixture shall be applied by means of a solution feeding chlorination device, or if approved by the Owner, the gas shall be fed directly from a chlorine cylinder through a standard "chlorinator" capable of regulating the rate of flow and the effective diffusion of gas within the pipe. The rate of chlorine gas/water mixture flow shall be in

- such proportion to the rate of water entering the pipe, that the chlorine dose applied to all of the water entering the newly laid pipe shall be at least fifty (50) parts per million.
- D. If approved by the Owner, a mixture of Calcium Hypochlorite, comparable to commercial products known as "H.T.H.", "Perchlor" or "Masochlor", of known chlorine content and water may be substituted as an alternate for liquid chlorine. If Calcium Hypochlorite and water mixture is used, it should then first be made into a paste and then thinned to a slurry; then shall be injected or pumped into the new pipe and accessories. The dosage of Calcium Hypochlorite shall be equivalent to a treatment of at least fifty (50) parts per million of available chlorine.
 - E. The preferable point of application of the chlorinating agent shall be at the beginning of the pipe line extension, or any valved section of it, through a corporation stop inserted in the newly laid pipe by means of a tapping saddle. Use of fire hydrants for insertion of the chlorinating agent is specifically prohibited. Water from the existing distribution system, or other source of supply, shall be controlled to flow very slowly while the pipe line is filled with the chlorinating agent.
 - F. Back pressure (causing a reversal of flow or negative pressure in the pipe being treated) shall be prevented.
 - G. Treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. This period shall be at least twelve (12) hours and no more than twenty-four (24) hours as may be directed. After the chlorine treated water has been retained for the required time, the chlorine residual at pipe extremities, and at other representative points shall be field tested. Residual chlorine, at any given test location, shall not be less than ten (10) parts per million.
 - H. In the process of chlorinating newly laid water pipe, all valves or other appurtenances shall be operated while the pipe line is filled with the chlorinating agent. I. Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipe at its extremities until the replacement water throughout its length shall, upon test, both chemically and bacteriologically be proved equal to the water quality being served to the public from the existing water supply and approved by the Owner Project Inspector.
 - I. Should the initial treatment in the opinion of the Owner Project Inspector, prove ineffective, the chlorination procedure shall be repeated until confirm tests show that water sampled from the newly laid pipe conforms to the requirements as specified above.
 - J. Unless the Owner shall direct otherwise, cuts made in existing lines for the insertion of valves, fittings, for repairs or for any other purpose, shall be disinfected by thoroughly wetting the interior of the pipes, fittings, etc., by spraying with a solution having a chlorine residual of 200 ppm. Contractor shall be responsible for ensuring no disinfection solution enters into the distribution system.
 - K. After flushing, the Project Inspector shall notify the Owner Environmental Laboratory that the main is ready for a bacteriological sample to be processed. Bacteriological test sites should be installed in accordance with the Drawings or as directed by the Owner Project Inspector and in compliance with Standard Details. Once the sample is processed, it must remain in incubation a minimum of twenty-four (24) hours before a "sample passed" certification from the Environmental Laboratory can be obtained. State Codes

require the collection of duplicate (2) "Passing" bacteriological samples prior to certification of the main.

- L. NOTE: When the environmental laboratory representative attempts to obtain an acceptable sample, if they observe air, discolored water, trash, debris, too high or no chlorine residual in the water, no sample will be taken until the main is re-flushed.

3.4 GUARANTEE

- A. The Contractor shall guarantee for a period of twelve (12) months from the final acceptance, all water mains, appurtenances, trenches, roadways, landscaping, and other areas disturbed by the construction of the project.
- B. The Contractor shall be responsible for repairs to any leaking pipe, fittings, etc. should trenches settle, he/she shall promptly furnish and place fill to original grade. Should any leaks or trench settlement occur under the new pavement, the Contractor will be held responsible for the cost of all repairs, including pavement replacement. No bell clamps or wrap around corsets are allowed as a means of repair on new pipelines.
- C. Within the guarantee period, where no loss of customer service or property damage is involved, the Contractor shall begin work on requested repairs or corrective measures with 24 hours following notification by Owner. If property damage or loss of customer service is involved, the Contractor shall begin work with four (4) hours of notification by Owner.

3.5 INSPECTION

- A. Furnish to Owner copies of the Manufacturer's Sworn Certificate of Inspection and Testing of all ductile iron pipe and ductile iron fittings provided on the Work. All ductile iron pipe and cast-iron fittings will be subject to inspection and approval by Owner after delivery of material to the site. Do not use broken, cracked, misshaped, imperfectly coated, unsatisfactory, or otherwise damaged pipe or fittings.
- B. Such inspection by Owner does not relieve the Contractor of full responsibility for the material installed.

END OF SECTION

SECTION 40 05 61.16
GATE VALVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies ductile iron-body, solid-wedge, resilient-seated gate valves.

1.2 QUALITY ASSURANCE

A. References

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI B16.1	Cast-iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
ASTM A536	Ductile Iron Castings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C515	Reduced Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
NSF 61	Drinking Water System Components – Health Effects

B. Design Criteria

1. Gate valves 3 inches through 48 inches in size shall comply with AWWA C509 or AWWA C515, including applicable hydrostatic testing. Valves shall be NSF 61 certified.

C. Factory Testing

1. Each valve shall be hydrostatic, seal, and operational tested and in accordance with AWWA C515.

1.3 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
1. Affidavit of compliance, as required by AWWA C515.
 2. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined shall signify compliance on the part of the Contractor with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further consideration.*
 3. Manufacturer's catalog information including dimensions, cross-sectional views, details of construction, and list of materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Materials of construction shall be as follows:

Component	Material
Body and wedge	Ductile iron, ASTM 536
Mounting	Bronze
Stem	Bronze, AWWA C500

- B. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. However, alternative materials must provide at least the same qualities as those specified for the purpose.

2.2 MANUFACTURE

- A. General
1. Resilient seat valves shall be of the nonrising stem type. The sealing mechanism shall consist of a solid ductile iron gate totally encapsulated with rubber. The valve shall be designated so that compression-set of the rubber shall not affect the ability of the valve to seal when unbalanced pressure is applied to either side of the gate. The sealing mechanism shall provide zero leakage at 250 psi working pressure when installed with the line flow in either direction. Valves shall be provided with O-ring stem seals.
 2. The gate shall be provided with a drain in the bottom to flush the internal cavity of foreign material each time the valve is opened.

3. Valves shall open to the left (counterclockwise) and be so marked.

B. End Connections

1. For exposed service conditions, gate valve end connections shall be flanged or threaded as specified. Threaded ends shall not be provided on gate valves with end connections larger than 4 inches. End flanges shall be integral with the gate valve body and be faced' and drilled in accordance with ANSI B16.1 for 125-pound flanges. Where flange joints are used, flanges must meet the requirements of AWWA C115, latest revision.
2. For buried or encased service conditions, gate valve end connections shall be mechanical joint, complete with all necessary jointing accessories.

C. Manual Operators

1. Valves shall be furnished with a 2-inch square, ductile iron operating nut. The operating nut shall be attached to the stem by either a completely recessed cap nut or by a stainless-steel pin. Valves shall be furnished with a "T Bar" operator.

D. Bypass (NOT USED)

E. Surface Linings and Coatings

1. All internal and external surfaces of the valve body and bonnet shall be coated with fusion bonded epoxy in accordance with AWWA C550.

2.3 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01 33 00:
1. Hydrostatic test results as required per specifications.

2.4 ACCEPTABLE MANUFACTURERS

- A. Mueller
- B. Clow
- C. Engineer and Owner Approved Equal

PART 3 EXECUTION

- A. Gate valves shall be installed in the closed position.

END OF SECTION

SECTION 40 05 73.13

ALTITUDE VALVES

PART 1 GENERAL

- A. Shall be furnished and installed by the contractor at the location shown in the construction drawings. Installation shall be done in accordance with the manufacturer's instructions. Valve shall be adjusted by the valve manufacturer's representative.
- B. Altitude valve shall be two-way globe type with Electric Solenoid to override altitude function and allow main valve to open fully during a power failure. The valve shall be provided with a valve position indicator and a limit switch assembly. Solenoid and limit switch shall operate on 24 VDC and have a NEMA 6 corrosion resistant enclosure. Valve shall be of the size shown on the construction drawings.
- C. Altitude Valve shall be two-way ductile iron body with flanged joints, trim shall be 316 stainless-steel; stem, spring and nut shall be stainless-steel and shall be Class 150 rated for a maximum pressure of 175 psi similar to AMES 960G-17 or approved equivalent. Valve shall be provided with large control filter.
- D. Associate altitude control pilot, liquid filled gauges, strainers, accessories, tubing, and fittings must be 316 stainless.

PART 2 NOT USED

PART 3 EXECUTION

- A. Altitude valves shall be installed in the closed position.

END OF SECTION