CITY OF CUMMING

CONTRACT DOCUMENTS

FOR

PWPF – PHASE 2 CLEARWELL IMPROVEMENTS

VOLUME 1

APRIL 2026

PRIME
A Stratus Team Company
3715 NORTHSIDE PARKWAY, NW
BUILDING 300 – SUITE 200
ATLANTA, GEORGIA 30327
(404) 425-7100

TABLE OF CONTENTS

Section Number	Title
DIVISION 00 – CONTRACT DOCUMENTS	
00 21 13	REQUEST FOR PROPOSALS
00 41 13	PROPOSAL FORM
00 43 13	PROPSAL BOND
00 45 16	STATEMENT OF PROPOSER'S QUALIFICATIONS
00 51 00	NOTICE OF AWARD
00 52 13	STANDARD FORM OF AGREEMENT
00 55 00	NOTICE TO PROCEED
00 61 14	PERFORMANCE BOND
00 61 15	PAYMENT BOND
00 62 15	CERTIFICATE OF OWNER'S ATTORNEY
00 62 16	CERTIFICATE OF INSURANCE
00 63 63	CHANGE ORDER FORM
00 65 19	FINAL LIEN WAIVER
00 72 00	GENERAL CONDITIONS
00 73 00	SUPPLEMENTAL CONDITIONS
DIVISION 01 – GENERAL REQUIREMENTS	
01 00 00	GENERAL REQUIREMENTS
01 11 00	SUMMARY OF WORK
01 11 10	GEOTECHNICAL INFORMATION
01 22 15	MEASUREMENT AND PAYMENT
01 31 19	PROJECT MEETINGS
01 32 33	PHOTOGRAPHIC DOCUMENTATION
01 33 00	SUBMITTAL PROCEDURES
01 41 00	REGULATORY REQUIREMENTS
01 42 19	REFERENCE STANDARDS
01 43 00	QUALITY ASSURANCE
01 45 29	TESTING LABORATORY SERVICES
01 50 00	TEMPORARY FACILITIES AND CONTROLS
01 60 00	PRODUCT REQUIREMENTS
01 65 00	PRODUCT DELIVERY REQUIREMENTS
01 66 00	PRODUCT STORAGE AND HANDLING REQUIREMENTS
01 71 23.16	CONSTRUCTION SURVEYING
01 73 29	CUTTING AND PATCHING
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 74 23	FINAL CLEANING
01 78 36	WARRANTIES
01 78 39	PROJECT RECORD DOCUMENTS
DIVISION 02 – EXISTING CONDITIONS	
02 32 19	EXPLORATORY EXCAVATION
02 41 13.13	PAVING REMOVAL
02 41 13.23	UTILITY LINE REMOVAL
02 42 11	REMOVAL OF CONSTRUCTION MATERIAL

Section Number	Title
DIVISION 03 - CONCRETE	
03 10 00	CONCRETE FORMING
03 20 00	CONCRETE REINFORCEMENT
03 30 00	CAST-IN-PLACE CONCRETE
03 61 00	FLOWABLE BACKFILL
DIVISION 04 - MASONRY	
04 20 00	UNIT MASONRY
04 21 13	BRICK MASONRY
04 43 00	STONE MASONRY
DIVISION 05 - METALS	
05 12 00	STRUCTURAL STEEL FRAMING
05 21 00	STEEL JOIST FRAMING
05 31 00	STEEL DECKING
05 40 00	COLD-FORMED METAL FRAMING
05 44 00	COLD-FORMED METAL TRUSSES
05 50 00	METAL FABRICATIONS
05 52 13	PIPE AND TUBE RAILINGS
05 53 13	BAR GRATINGS
DIVISION 07 – THERMAL AND MOISTURE PROTECTION	
07 13 00	PRE-APPLIED UNDERSLAB WATERPROOFING MEMBRANE
07 13 26	SELF-ADHERING SHEET WATERPROOFING
07 14 16	COLD FLUID-APPLIED WATERPROOFING
07 18 00	TRAFFIC COATINGS
07 21 00	THERMAL INSULATION
07 27 26	FLUID-APPLIED MEMBRANE AIR BARRIERS
07 41 13.16	STANDING-SEAM-METAL ROOF PANELS
07 42 13	METAL WALL PANELS
07 54 23	THERMOPLASTIC POLYOLEFIN (TPO) ROOFING
07 72 00	ROOF ACCESSORIES
07 92 00	JOINT SEALANTS
DIVISION 08 - OPENINGS	
08 11 13	HOLLOW METAL DOORS AND FRAMES
08 33 23	OVERHEAD COILING DOORS
08 71 00	FINISH DOOR HARDWARE
08 91 19	FIXED LOUVERS
DIVISION 09 - FINISHES	
09 51 00	ACOUSTICAL CEILINGS
09 90 00	PAINTING AND COATING
09 96 00	HIGH-PERFORMANCE COATINGS

Section Number Title

DIVISION 22 – PLUMBING

22 04 00 GENERAL REQUIREMENTS FOR PLUMBING
22 05 23 GENERAL – DUTY VALVES FOR PLUMBING PIPING
22 05 29 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPEMENT
22 05 53 PAINTING AND IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
22 07 00 PLUMBING INSULATION
22 11 16 DOMESTIC WATER PIPING
22 11 19 DOMESTIC WATER PIPING SPECIALTIES
22 13 16 SANITARY WASTE AND VENT PIPING
22 13 19 SANITARY WASTE PIPE SPECIALTIES
22 33 00 ELECTRIC, DOMESTIC WATER HEATERS
22 40 00 PLUMBING FIXTURES
22 61 13 COMPRESSED-AIR PIPING

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING (HVAC)

23 00 10 HVAC GENERAL REQUIREMENTS
23 01 00 OPERATION AND MAINTENANCE OF HVAC SYSTEMS
23 05 00 COMMON WORK RESULTS FOR HVAC
23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC
23 07 00 HVAC INSULATION
23 08 00 COMMISSIONING OF HVAC
23 09 93 SEQUENCE OF OPERATIONS FOR HVAC CONTROLS
23 20 00 HVAC PIPING AND PUMPS
23 30 00 HVAC AIR DISTRIBUTION
23 70 00 CENTRAL HVAC EQUIPMENT
23 80 00 DECENTRALIZED HVAC EQUIPMENT

Section Number Title

DIVISION 26 - ELECTRICAL

26 01 35 ELECTRICAL GENERAL
26 05 19 600 VOLT ELECTRICAL POWER CONDUCTORS AND CABLES
26 05 23 CONTROL AND INSTRUMENTATION CONDUCTORS AND CABLES
26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 33 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
26 05 43 UNDGROUND DUCTS AND REACEWAYS FOR ELECTRICAL SYSTEMS
26 05 44 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING
26 05 53 IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 09 17 PROTECTIVE RELAYS
26 12 16 MEDIUM VOLTAGE DRY TYPE VPI TRANSFORMERS
26 13 13 MEDIUM-VOLTAGE, METAL-ENCLOSED CIRCUIT BREAKER SWITCHGEAR
26 22 00 600 VOLT TRANSFORMERS
26 23 00 600 VOLT SWITCHGEAR
26 24 16 600 VOLT PANELBOARDS
26 27 26 WIRING DEVICES
26 28 16 ENCLOSED SWITCHES AND ENCLOSED CIRCUIT BREAKERS
26 32 13 ENGINE GENERATORS
26 51 00 INTERIOR LIGHTING
26 56 00 EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

27 13 00 COMMUNICATIONS BACKBONE CABLING

DIVISION 31 - EARTHWORK

31 11 00 CLEARING AND GRUBBING
31 13 11 TEMPORARY FENCING
31 20 00 EARTH MOVING
31 23 00 EXCAVATION AND FILL
31 23 19 DEWATERING
31 25 00 EROSION AND SEDIMENTATION CONTROL
31 50 00 EXCAVATION SUPPORT AND PROTECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 01 19.61 JOINT SEALING IN CONCRETE PAVEMENT
32 12 16 REMOVING AND REPLACING PAVEMENT
32 13 13 CONCRETE PAVING
32 13 73 CONCRETE PAVING JOINT SEALANTS
32 16 13 SIDEWALKS, CURBS, AND GUTTERS
32 31 13 CHAIN LINK FENCES AND GATES
32 73 00 WETLANDS PROTECTION
32 91 13 SOIL PREPARATION FOR LANDSCAPING
32 92 00 TURF AND GRASSES
32 92 10 TREE REMOVAL AND PROTECTION
32 93 00 PLANTS
32 93 43 TREE REPLACEMENT

Section Number Title

DIVISION 33 - UTILITIES

33 01 30.13 SEWER AND MANHOLE TESTING
33 05 00 COMMON WORK RESULTS FOR UTILITIES
33 05 13 MANJOLE FRAMES AND COVERS
33 05 16.13 PRECAST CONCRETE UTILITY STRUCTURES
33 05 23.16 UTILITY PIPE JACKING
33 10 00 WATER UTILITIES
33 11 15 VALVES AND APPURTENANCES FOR SITE UTILITIES
33 12 16 WATER UTILITY DISTRIBUTION VALVES
33 12 16.13 ALTITUDE CONTROL VALVE
33 31 00 SANITARY UTILITY SEWERAGE PIPING
33 33 00 DUCTILE IRON PIPE AND FITTINGS
33 39 15 MANHOLE HEIGHT ADJUSTMENT
33 41 00 STORM UTILITY DRAINAGE PIPING
33 41 13 REINFORCED CONCRETE PIPE FOR STORM DRAINS

DIVISION 34 - TRANSPORTATION

34 41 16.10 TRAFFIC CONTROL
34 71 00 ROADWAY CONSTRUCTION

DIVISION 40 – INSTRUMENTATION AND CONTROLS

40 90 01 GENERAL REQUIREMENTS FOR INSTRUMENTATION AND CONTROL
40 94 43 PROGRAMMABLE LOGIC CONTROLLER
40 95 16 INSTRUMENT AND CONTROL PANELS
40 95 51 TRANSMITTERS
40 96 20 INSTRUMENT INDEX
40 96 35 PROCESS CONTROL SYSTEM DEVELOPMENT AND PROGRAMMING
40 98 00 PROCESS INSTRUMENTATION AND CONTROL TESTING

DIVISION 41 – MATERIAL PROCESSING AND MATERIAL HANDLING EQUIPMENT

41 22 00 CRANES AND HOISTS

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

46 21 53 VERTICAL TURBINE PUMPS
46 21 54 VERTICAL TURBINE PUMPS BACKWASH

APPENDIX

APPENDIX A GEFA AMERICAN IRON AND STEEL SPECIAL CONDITIONS AND INFORMATION
APPENDIX B GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECCIAL CONDITIONS
APPENDIX C GEFA SUPPLEMENTAL GENERAL CONDITIONS
APPENDIX D APPLICABLE WAGE DECISION
APPENDIX E DAVIS-BACON SUBRECIPIENT COMPLIANCE REPORT
APPENDIX F GEOTECHNICAL REPORT

SECTION 00 21 13
REQUEST FOR PROPOSALS

The City of Cumming (Owner) is requesting Proposals from qualified contractors for the construction of the following Project:

City of Cumming – #732-2 – PWPF – PHASE 2 CLEARWELL IMPROVEMENTS

Project Description:

PWPF – Clearwell Improvements: The Project will involve furnishing all materials, labor, and equipment to install a new six (6) million-gallon clearwell, a new electrical building sized and arranged for future electrical upgrades, new yard piping connecting various parts of the proposed and existing facilities, and a new access road to this area. The electrical upgrades shall include coordinating contractor's scope of work with Ga Power's scope to provide power prior to commissioning.

Proposal Documents:

All **Proposal Documents** may be obtained from Prime Engineering, Inc. upon payment of $25.00 (non-refundable) by contacting David Valenzuela @ David.Valenzuela@stratusteam.com, Ted Turner @ tturner@prime-eng.com **AND** Kalyn Keeney @ kkeeney@prime-eng.com. **Ensure all parties copied on your email correspondence.** The Proposer shall be placed on the Plan Holders list, receive electronic copies of Proposal Documents, and be eligible to submit a proposal on the project. Checks should be made payable to **City of Cumming** and mailed to Ted Turner c/o Prime Engineering, Inc. at 3715 Northside Parkway, NW, Building 300 – Suite 200, Atlanta, GA 30327. Please reference the project and include the name, phone number, and email address of your company contact. **Hard copies of the Contract Documents will not be available**.

Pre-Proposal Conference:

A Pre-Proposal Conference for the Project will be held on **Tuesday, May 12, 2026**, 1**:00 pm** at **Cumming City Hall** located at **100 Main Street, Cumming, GA 30040.**

Examination of Contract Documents and Site:

It is the responsibility of each Bidder, before submitting a Bid, to (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with the local conditions that may in any manner affect cost, progress, performance or furnishing of the work, (c) consider federal, state and local laws, ordinances, rules and regulations that may in any manner affect cost, progress, performance or furnishing of the work; (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Owner/Engineer of all conflicts, errors of discrepancies in the Contract Documents.

Bidders shall schedule any on-site visits, prior to proposal submittal, with Sam Rawlings @ (470) 421-1264 or SRawlins@cummingutilities.com

Proposal Due Date:

Proposals for the construction of the project will be accepted at **Cumming City Hall, Utility Department – Front Desk** located at **100 Main Street, Cumming, GA 30040**, no later than **June 26, 2026,** at **11:00 am EST**. Any proposals received after this appointed time will be considered late and will be returned unopened to the Proposer. The Proposal due date can be changed only by addendum.

Proposer Questions:

The last day for submission of questions shall be No Later Than **4:00pm, Monday June 8, 2026**. All Proposer's questions shall be made in writing and addressed to Ted Turner at tturner@prime-eng.com.

Procurement Schedule:

RFP Issued: **Monday, April 27, 2026**
Pre-Proposal Conference: **Tuesday, May 12, 2026, 1:00 pm**
Deadline for Proposer's Questions: **Monday, June 8, 2026, 4:00 pm**
Answers to Proposer's Questions: **Friday, June 12, 2026, 4:00 pm**
Proposal Due Date: **Friday, June 26, 2026, 11:00 am**

Instructions to Proposers:

Proposers interested in the Work are instructed to submit three (3) original hard copies and one (1) electronic copy (non-returnable USB flash drive) of its complete proposal in accordance with this RFP, No Later Than **Friday, June 26, 2026,** at **11:00 am EDT,** unless otherwise changed through an addendum to this RFP, to Cumming City Hall, Utility Department located at 100 Main Street, Cumming, GA 30040. Any proposals received after this appointed date and time will not be considered and will be returned unopened to the Proposer.

All Proposals and all attachments must be submitted and delivered in a ***SEALED***, non-transparent envelope to City of Cumming Utility Department at the address shown below no later than the date and time set for receipt of Proposals. Deliver OR mail the Proposal in a sealed envelope/package to:

CITY OF CUMMING UTILITY DEPARTMENT
ATTN: JON HEARD
100 MAIN STREET
CUMMING, GA 30040

The front lower right corner of each ***SEALED*** envelope/package must contain the following information for proper identification:

PWPF – Phase 2 Clearwell Improvements
RFP #732-2
DUE: Friday, June 26, 2026 AT 11:00 EDT

1. Include Proposer name, address, phone number, and contact person on each sealed envelope/package.
2. If Proposal is contained in multiple envelopes/packages, number each sealed envelope/package sequentially, (i.e. "1 of 3", "2 of 3", "3 of 3", etc.).

All Proposals received no later than the appointed date and time will be date stamped at the City of Cumming Utility Department located at 100 Main Street, Cumming, GA 30040.

Submission of Proposals by fax, email, website or other electronic means will not be accepted. Any Proposals received after the stated date and time will not be considered. Late proposals will not be opened at the public opening. Arrangements may be made for the unopened proposals to be returned at the Proposer's request and expense.

Proposals may be withdrawn or modified only by written notification from the Proposer *prior to* the appointed date and time for the opening of Proposals. Negligence on the part of the Proposer in preparing the Proposal confers no right for withdrawal of the Proposer after it has been opened.

The City of Cumming Utility Department reserves the right to seek additional/supplemental representation on specific issues as needed.

Proposals should be typed. **No changes in or corrections to Proposals will be allowed after the Proposals are opened**.

The signer of the Proposal must declare that the Proposal is fair and in good faith, without collusion or fraud, and that the signer of the Proposal has the authority to bind the principal Proposer.

The City will not be liable for any costs incurred by Proposer prior to entering into a contract. Therefore, all Proposers are encouraged to provide a simple, straightforward, and concise description of their abilities to meet the RFP requirements.

Required Forms, Documents and Certifications:

A satisfactory **Proposal Bond** (in the amount of 5% of the Proposal Amount), executed by the Proposer and an acceptable surety company listed in the latest issue of U.S. Treasury Circular 570, shall accompany the Proposal. The Owner reserves the right to: reject any or all Proposals, waive any informality, evaluate Proposals, and accept any Proposal, which in their opinion, may be in their best interest.

The following forms must be fully filled out and signed by a person with authority to bind the Proposer, notarized where applicable, and shall accompany the Proposal:

Section 00 41 13 Proposal Form
Section 00 43 13 Proposal Bond Form and required attachment(s)
Section 00 45 16 Statement of Proposer Qualifications and required Schedules

The successful Proposer for this Contract will be required to furnish a satisfactory **Performance Bond** and a Labor and Material **Payment Bond**, with a corporate surety **licensed to do business in the State of Georgia, with a rating of not less than A-** and approved by the OWNER and listed in the latest issue of U.S. Treasury Circular 570, with each Bond in the amount of 100% of any awarded Contract amount. Performance and Payment Bonds are **NOT** required to propose, however, shall be required after award.

Proposal Evaluation:

Each proposal will be reviewed to determine whether it has been submitted in accordance with the proposal requirements. Proposals deemed non-responsive will be rejected from further review and the Proposer will be notified in writing.

Proposals deemed responsive will be evaluated on the evaluation criteria set forth in this RFP. Selection will include an analysis of proposals by an Evaluation Committee composed of City personnel who will review the proposal submittals in accordance with the submittal requirements and the evaluation criteria set forth in this RFP. Other factors, as detailed in the RFP, will be considered in determining which proposal will be deemed best to meet the needs of City of Cumming Utility Department. Award will not necessarily be based on cost alone. The City of Cumming Utility Department reserves the right to reject any and all Proposals

Evaluation Criteria:

SECTION 00 41 13
PROPOSAL FORM

ARTICLE 1—OWNER AND PROPOSER

1.1 This Proposal is submitted to: **The City of Cumming, City Hall, Utility Department - Front Desk; Attn: Jon Heard at 100 Main Street, Cumming, GA 30040**.

1.2 The undersigned Proposer proposes and agrees, if this Proposal is accepted, to enter into an Agreement with Owner in the form included in the Proposal Documents to perform all Work as specified or indicated in the Proposal Documents for the prices and within the times indicated in this Proposal and in accordance with the other terms and conditions of the Proposal Documents.

ARTICLE 2—ATTACHMENTS TO THIS PROPOSAL

2.1 The following documents are submitted with and made a condition of this Proposal:

A. Required Proposal security

B. List of Proposed Subcontractors

C. List of Proposed Suppliers

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Proposals

E. Contractor’s license number as evidence of Proposer’s State Contractor’s License or a covenant by Proposer to obtain said license within the time for acceptance of Proposals. Contractor shall have the ability to perform utility work at the project location.

F. Required Proposer Qualification Statement with supporting data.

ARTICLE 3—BASIS OF PROPOSAL—UNIT PRICES

3.1 **Proposer shall enter a proposal for Phase 2 Clearwell Improvements below.**

A. Proposer will perform the following Work at the indicated unit prices:

PWPF PHASE 2 CLEARWELL IMPROVEMENTS

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
1.1	**6 Million Gallon Clearwell**				
1.1.1	Demolition	LS		$	$
1.1.2	Site clearing, grubbing, grading	LS		$	$
1.1.2.1	Dirt Spoilage	LS		$	$
1.1.2	Ground Improvement	LS		$	$
1.1.3	Clearwell, Complete	LS		$	$
1.1.4	Electrical and Instrumentation Controls, Complete	LS		$	$

1.2	**Modifications to 1 MG Clearwell**				
1.2.1	Selective Demolition	LS		$	$
1.2.2	Piping Work	LS		$	$
1.2.3	Pump Work (Existing and New)	LS		$	$
1.2.3.1	Controls and Instrumentation	LS		$	$
1.2.4	Existing Clearwell Electrical Modifications, Complete	LS		$	$
1.2.5	Commissioning	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
1.3	**Modifications to 2 MG Clearwell**				
1.3.1	Selective Demolition	LS		$	$
1.3.2	Piping Work	LS		$	$
1.3.3	Pump Work (Existing and New)	LS		$	$
1.3.3.1	Controls and Instrumentation	LS		$	$
1.3.4	Existing Vent Modifications	LS		$	$
1.3.5	Commissioning	LS		$	$

2	**Water Utilities Piping**				
2.1	Piping	LF		$	$
2.2	Valve Installation	LS		$	$
2.3	Vaults and Other Precast Structures	LS		$	$

3	**Storm Sewer**				
3.1	Piping	LF		$	$
3.2	Precast/Poured Structures	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
4	**Sanitary Sewer**				
4.1	Piping	LF		$	$
4.2	Precast Structures	LS		$	$

5	**Site Concrete**				
5.1	Retaining Wall	LS		$	$
5.2	Sidewalk	LS		$	$
5.3	Miscellaneous Concrete	LS		$	$

6	**Pavement**				
6.1	Asphalt	LS		$	$

7	**E & S Control**				
7.1	Erosion and Sediment Control	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
8	**Electrical Building**				
8.1	Site Clearing and Grubbing	LS		$	$
8.2	Ground Improvement	LS		$	$
8.3	Electrical Building, Complete	LS		$	$
8.4	Building Internals				
8.4.1	Switchgear	LS		$	$
8.4.2	MCC Sections	LS		$	$
8.4.3	Transformers	LS		$	$
8.4.4	Electrical Panels	LS		$	$
8.5	Controls				
8.5.1	I/O Panels	LS		$	$
8.5.2	VFDs	LS		$	$
8.5.3	Controls Integration	LS		$	$
8.5.4	Instrumentation	LS		$	$
8.6	Air Compressor Relocation	LS		$	$
8.7	Interfacing with Ga Power for EMGR. Gen Sets	LS		$	$
8.8	Commissioning	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
9.1	**Concrete Encased Duct Bank**				
9.1.1	Duct Bank	LS		$	$
9.1.2	Vaults or other Precast Structures	LS		$	$

9.2	**Electrical Conduit and Conductors**				
9.2.1	Conduit, Duct, or Raceways not otherwise included	LS		$	$
9.2.2	Conductors, Cables, Wiring	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
10	**Owner Directed Work**				
10.1	Miscellaneous (Owner Allowance)	LS	1	$ 1,000,000	$ 1,000,000

Proposer: _____

Signature: _____

Name: _____

Title: _____

Date: _____

ARTICLE 4—TIME OF COMPLETION

4.1 Proposer agrees that the Work will be substantially complete within **425 days** calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.1 of the General Conditions or **30 days** after delivery of all major equipment and will be completed and ready for final payment in accordance with Paragraph 15.6 of the General Conditions. The time of completion is the same for both Divisions.

4.2 Proposer accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—PROPOSER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.1 *Proposal Acceptance Period*

A. This Proposal will remain subject to acceptance for 30 days after the Proposal opening, or for such longer period of time that Proposer may agree to in writing upon request of Owner.

5.2 *Instructions to Proposers*

A. Proposer accepts all the terms and conditions of the Instructions to Proposers, including without limitation those dealing with the disposition of Proposal security.

5.3 *Receipt of Addenda*

A. Proposer hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—PROPOSER'S REPRESENTATIONS AND CERTIFICATIONS

6.1 *Proposer's Representations*

A. In submitting this Proposal, Proposer represents the following:

1. Proposer has examined and carefully studied the Proposal Documents, including Addenda.
2. Proposer has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Proposer is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Proposer has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the

Supplementary Conditions, with respect to the Technical Data in such reports and drawings.

5. Proposer has considered the information known to Proposer itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Proposal Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Proposer, if selected as Contractor; and (c) Proposer's (Contractor's) safety precautions and programs.
6. Based on the information and observations referred to in the preceding paragraph, Proposer agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
7. Proposer is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Proposal Documents.
8. Proposer has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Proposer has discovered in the Proposal Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
9. The Proposal Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
10. The submission of this Proposal constitutes an incontrovertible representation by Proposer that without exception the Proposal and all prices in the Proposal are premised upon performing and furnishing the Work required by the Proposal Documents.

6.2 *Proposer's Certifications*

A. The Proposer certifies the following:

1. This Proposal is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2. Proposer has not directly or indirectly induced or solicited any other Proposer to submit a false or sham Proposal.
3. Proposer has not solicited or induced any individual or entity to refrain from Proposing.
4. Proposer has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.2.A:
    a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the Proposal process.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the Proposal process to the detriment of Owner, (b) to establish Proposal prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. Collusive practice means a scheme or arrangement between two or more Proposers, with or without the knowledge of Owner, a purpose of which is to establish Proposal prices at artificial, non-competitive levels.

d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the Proposal process or affect the execution of the Contract.

PROPOSER hereby submits this Proposal as set forth above:

Proposer: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

If Proposer is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Address for giving notices:

_____

_____

Proposer's Contact:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address: _____

Proposer's Georgia Utility Contractor's License No.: _____

SECTION 00 43 13
PROPOSAL BOND

Proposer Name: Address *(principal place of business)*:	**Surety** Name: Address *(principal place of business)*:
Owner Name: **City of Cumming** Address: **100 Main Street** **Cumming, Ga 30040**	**Proposal** Project: **City of Cumming – PWPF – CLEARWELL IMPROVEMENTS** Proposal Due Date: **Friday, June 26, 2026**
Bond Bond Amount: Date of Bond:	
Surety and Proposer, intending to be legally bound hereby, subject to the terms set forth in this Proposal Bond, do each cause this Proposal Bond to be duly executed by an authorized officer, agent, or representative.	

Proposer	**Surety**
_____ *(Full formal name of Proposer)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature) (Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

1. Proposer and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Proposal any difference between the total amount of Proposer's Proposal and the total amount of the Proposal of the next lowest, responsible Proposer that submitted a responsive Proposal, as determined by Owner, for the work required by the Contract Documents, provided that:

   1.1. If there is no such next Proposer, and Owner does not abandon the Project, then Proposer and Surety shall pay to Owner the bond amount set forth on the face of this Bond, and

   1.2. In no event will Proposer's and Surety's obligation hereunder exceed the bond amount set forth on the face of this Bond.

   1.3. Recovery under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Proposal.

2. Default of Proposal occurs upon the failure of Proposer to deliver within the time required by the Proposing Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Proposing Documents and any performance and payment bonds required by the Proposing Documents.

3. This obligation will be null and void if:

   3.1. Owner accepts Proposer's Proposal and Proposer delivers within the time required by the Proposing Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Proposing Documents and any performance and payment bonds required by the Proposing Documents, or

   3.2. All Proposals are rejected by Owner, or

   3.3. Owner fails to issue a Notice of Award to Proposer within the time specified in the Proposing Documents (or any extension thereof agreed to in writing by Proposer and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Proposer and within 30 calendar days after receipt by Proposer and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Proposer, provided that the total time for issuing Notice of Award including extensions will not in the aggregate exceed 120 days from Proposal due date without Surety's written consent.

6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Proposer and Surety, and in no case later than one year after the Proposal due date.

7. Any suit or action under this Bond must be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder must be in writing and sent to Proposer and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.

11. The term “Proposal” as used herein includes an offer or proposal as applicable.

SECTION 00 45 16
STATEMENT OF PROPOSER'S QUALIFICATIONS

ARTICLE 1—GENERAL INFORMATION

1.01 Provide contact information for the Business:

Legal Name of Business:			
Corporate Office			
Name:		Phone number:	
Title:		Email address:	
Business address of corporate office:			
Local Office			
Name:		Phone number:	
Title:		Email address:	
Business address of local office:			

1.02 Provide information on the Business's organizational structure:

Form of Business:	☐ Sole Proprietorship ☐ Partnership ☐ Corporation		
☐ Limited Liability Company ☐ Joint Venture comprised of the following companies:			
	1.		
	2.		
	3.		
Provide a separate Qualification Statement for each Joint Venturer.			
Date Business was formed:		State in which Business was formed:	
Is this Business authorized to operate in the Project location?	☐ Yes ☐ No ☐ Pending		

1.03 Identify all businesses that own Business in whole or in part (25% or greater), or that are wholly or partly (25% or greater) owned by Business:

Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	
Address:			
Name of business:		Affiliation:	

Address:	

1.04 Provide information regarding the Business's officers, partners, and limits of authority.

Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	
Authorized to sign contracts: ☐ Yes ☐ No		Limit of Authority:	$
Name:		Title:	

ARTICLE 2—LICENSING

2.01 Provide information regarding licensure for Business:

Name of License:			
Licensing Authority:			
License No:		Expiration Date:	
Name of License:			
Licensing Authority:			
License No:		Expiration Date:	

ARTICLE 3—CONSTRUCTION EXPERIENCE

3.01 Provide information that will identify the overall size and capacity of the Business.

Average number of current full-time employees:	
Estimate of revenue for the current year:	
Estimate of revenue for the previous year:	

3.02 Provide information regarding the Business's previous contracting experience.

Years of experience with projects like the proposed project:				
As a general contractor:		As a joint venture:		
Has Business, or a predecessor in interest, or an affiliate identified in Paragraph 1.03:				
Been disqualified as a Proposer by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been barred from contracting by any local, state, or federal agency within the last 5 years? ☐ Yes ☐ No				
Been released from a proposal in the past 5 years? ☐ Yes ☐ No				

Defaulted on a project or failed to complete any contract awarded to it? ☐ Yes ☐ No
Refused to construct or refused to provide materials defined in the contract documents or in a change order? ☐ Yes ☐ No
Been a party to any currently pending litigation or arbitration? ☐ Yes ☐ No
Provide full details in a separate attachment if the response to any of these questions is Yes.

3.03 In Schedule A, list all projects currently under contract and provide indicated information.

3.04 In Schedule B, list a minimum of three (3) and a maximum of six (6) projects completed in the last 5 years and provide indicated information to demonstrate the Business's experience with projects similar in type and cost of construction.

3.05 In Schedule C, provide information on key individuals whom Business intends to assign to the Project. Provide resumes for those individuals included in Schedule C. Key individuals include the Project Manager, Project Superintendent, Quality Manager, and Safety Manager. Resumes may be provided for Business's key leaders as well.

ARTICLE 4—REQUIRED ATTACHMENTS

4.01 Provide the following information with the Statement of Qualifications:

A. If Business is a Joint Venture, separate Qualifications Statements for each Joint Venturer, as required in Paragraph 1.02.

B. Diverse Business Certifications, *if required* by Paragraph 2.01.

C. Attachments providing additional information as required by Paragraph 3.02.

D. Schedule A (Current Projects) as required by Paragraph 3.03.

E. Schedule B (Previous Experience with Similar Projects) as required by Paragraph 3.04.

F. Schedule C (Key Individuals) and resumes for the key individuals listed, as required by Paragraph 3.05.

G. Schedule D (E-Verify Compliance) Contractor Affidavit and Agreement.

This Statement of Qualifications is offered by:

Business: _____
(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(date signed)

(If Business is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Mailing Address for Notices:

_____
_____
_____

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

_____
_____
_____

Phone: _____

Email: _____

Schedule A—Current Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					

	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction					

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule B—Previous Experience with Similar Projects

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					
Name of Organization					
Project Owner			Project Name		
General Description of Project					
Project Cost			Date Project Completed		
Key Project Personnel	Project Manager		Project Superintendent		
Name					
Reference Contact Information (listing names indicates approval to contacting the names individuals as a reference)					
	Name	Title/Position	Organization	Telephone	Email
Owner					
Designer					
Construction Manager					

Schedule C—Key Individuals

Project Manager			
Name of individual			
Years of experience as project manager			
Years of experience with this organization			
Number of similar projects as project manager			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Project Superintendent			
Name of individual			
Years of experience as project superintendent			
Years of experience with this organization			
Number of similar projects as project superintendent			
Number of similar projects in other positions			
Current Project Assignments			
Name of assignment		Percent of time used for this project	Estimated project completion date
Reference Contact Information (listing names indicates approval to contact named individuals as a reference)			
Name		Name	
Title/Position		Title/Position	
Organization		Organization	
Telephone		Telephone	
Email		Email	
Project		Project	
Candidate's role on project		Candidate's role on project	

Schedule D—E-Verify Compliance Affidavit

CONTRACTOR E-VERIFY AFFIDAVIT AND AGREEMENT

(THIS FORM SHOULD BE FULLY COMPLETED AND RETURNED WITH YOUR SUBMITTAL AND WILL BE REQUIRED PRIOR TO EVALUATION)

By executing this affidavit, the undersigned contractor verifies its compliance with The Illegal Immigration Reform Enhancements for 2013, stating affirmatively that the individual, firm, or corporation which is contracting with the City of Cumming has registered with and is participating in a federal work authorization program* to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act, in accordance with the applicability provisions and deadlines established therein.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services or the performance of labor pursuant to this contract with the City of Cumming, contractor will secure from such subcontractor(s) similar verification of compliance with the Illegal Immigration Reform and Enforcement Act on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and provide a copy of each such verification to the City of Cumming at the time the subcontractor(s) is retained to perform such service.

_____ _____
E-Verify * User Identification Number Date Registered

_____
Legal Company Name

_____
Company Address

_____ _____
BY: Authorized Officer or Agent Date
(Contractor Signature)

_____
Title of Authorized Officer or Agent of Contractor

_____
Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN
BEFORE ME ON THIS

THE__DAY OF _____, 2024

_____
Notary Public

* As of the effective date of O.C.G.A. 13-10-91, the applicable federal work authorization program is "E- Verify" operated by the U.S. Citizenship and Immigration Services Bureau of the U.S. Department of Homeland Security, in conjunction with the Social Security Administration (SSA).

I, _____, certify that I am _____ of the Proposer, and that the answers to the foregoing questions and statements contained therein are true and correct.

PROPOSER: _____

By: _____

(name signed)

_____

(name printed or typed)

Title: _____

Date: _____

Subscribed and sworn to me this ___ day of _____, 20 ___.

NOTARY PUBLIC: _____

(name signed)

_____

(name printed or typed)

Commission Expires: _____

(Date)

(SEAL)

SECTION 00 51 00
NOTICE OF AWARD

Date of Issuance: _____

Owner: **CITY OF CUMMING**

Engineer: **PRIME ENGINEERING, INC.**

Project: **PWPF – PHASE 2 CLEARWELL IMPROVEMENTS**

Contractor: _____

Contractor's Address: _____

You are notified that Owner has accepted your Proposal dated _____ for the above Contract, and that you are the Successful Proposer and are awarded a Contract for:

City of Cumming – PWPF – PHASE 2 CLEARWELL IMPROVMENTS

The Contract Price of the awarded Contract is **$**_____. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Proposers and in the General Conditions, Articles 2 and 6.

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Proposal security forfeited.

ACCEPTANCE OF NOTICE

Receipt of the above **NOTICE OF AWARD** is hereby acknowledged by

Owner: **CITY OF CUMMING**

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Contractor: _____

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

SECTION 00 52 13

**STANDARD FORM OF AGREEMENT
BETWEEN OWNER AND CONTRACTOR
ON THE BASIS OF STIPULATED PRICE**

This Agreement is by and between **THE CITY OF CUMMING** ("Owner") and _____ ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—THE PROJECT

1.1 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

CITY OF CUMMING – PWPF – PHASE 2 CLEARWELL IMPROVEMENTS

ARTICLE 2—WORK

2.1 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

PWPF – Phase 2 Clearwell Improvements: The Project will involve furnishing all materials, labor, and equipment to install a new six (6) million-gallon clearwell, a new electrical building sized and arranged for future electrical upgrades, new yard piping connecting various parts of the proposed and existing facilities, and a new access road to this area. The electrical upgrades shall include coordinating contractor's scope of work with Ga Power's scope to provide power prior to commissioning.

ARTICLE 3—ENGINEER

3.1 The Owner has retained **PRIME ENGINEERING, INC.** ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.2 The part of the Project that pertains to the Work has been designed by Engineer, and that same entity prepared the design.

ARTICLE 4—CONTRACT TIMES

4.1 *Time is of the Essence*

A. All time limits for Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.2 *Contract Times*

A. Notice to Proceed Date is estimated **August 2026 .**

B. The Work will be substantially completed on or before **October 2027.**

4.3 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.1 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $500.00 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item).

ARTICLE 6—PWPF PHASE 2 CLEARWELL IMPROVEMENTS

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
1.1	**6 Million Gallon Clearwell**				
1.1.1	Demolition	LS		$	$
1.1.2	Site clearing, grubbing, grading	LS		$	$
1.1.2	Ground Improvement	LS		$	$
1.1.3	Clearwell, Complete	LS		$	$
1.1.3.1	Dirt Spoilage	LS		$	$
1.1.4	Electrical Controls, Complete	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
1.2	**Modifications to 1 MG Clearwell**				
1.2.1	Selective Demolition	LS		$	$
1.2.2	Piping Work	LS		$	$
1.2.3	Pump Work (Existing and New)	LS		$	$
1.2.3.1	Controls and Instrumentation	LS		$	$
1.2.4	Existing Clearwell Electrical Modifications, Complete	LS		$	$
1.2.5	Commissioning	LS		$	$

1.3	**Modifications to 2 MG Clearwell**				
1.3.1	Selective Demolition	LS		$	$
1.3.2	Piping Work	LS		$	$
1.3.3	Pump Work (Existing and New)	LS		$	$
1.3.3.1	Controls and Instrumentation	LS		$	$
1.3.4	Existing Vent Modifications	LS		$	$
1.3.5	Commissioning	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
2	**Water Utilities Piping**				
2.1	Piping	LS		$	$
2.2	Valve Installation	LS		$	$
2.3	Vaults and Other Precast Structures	LS		$	$
3	**Storm Sewer**				
3.1	Piping	LF		$	$
3.2	Precast/Poured Structures	LS		$	$
4	**Sanitary Sewer**				
4.1	Piping	LF		$	$
4.2	Precast/Poured Structures	LS		$	$
5	**Site Concrete**				
5.1	Retaining Wall	LS		$	$
5.2	Sidewalk	LS		$	$
5.3	Miscellaneous Concrete	LS		$	$
6	**Pavement**				
6.1	Asphalt	LS		$	$
7	**E & S Control**				
7.1	Erosion and Sediment Control	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
8	**Electrical Building**				
8.1	Site Clearing and Grubbing	LS		$	$
8.2	Ground Improvement	LS		$	$
8.3	Electrical Building, Complete	LS		$	$
8.4	Building Internals				
8.4.1	Switchgear	LS		$	$
8.4.2	MCC Sections	LS		$	$
8.4.3	Transformers	LS		$	$
8.4.4	Electrical Panels	LS		$	$
8.5	Controls				
8.5.1	I/O Panels	LS		$	$
8.5.2	VFDs	LS		$	$
8.5.3	Controls Integration	LS		$	$
8.5.4	Instrumentation	LS		$	$
8.6	Air Compressor Relocation	LS		$	$
8.7	Interfacing with Ga Power EMGR. Gen Sets	LS		$	$
8.8	Commissioning	LS		$	$

Item No.	Description	Unit	Approx. Quantity	Unit Price	Total Price
9.1	**Concrete Encased Duct Bank**				
9.1.1	Duct Bank	LS		$	$
9.1.3	Vaults or other Precast Structures	LS		$	$
9.2	**Electrical Conduit and Conductors**				
9.2.1	Conduit, Duct, or Raceways not otherwise included	LS		$	$
9.2.2	Conductors, Cables, Wiring	LS		$	$
10	**Owner Directed Work**				
10.1	Miscellaneous	LS	1	$ 1,000,000	$ 1,000,000

ARTICLE 7—PAYMENT PROCEDURES

6.1 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.2 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **1st** day of each month during performance of the Work as provided in Paragraph 5.1 above, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

a. **95%** of the value of the Work completed (with the balance being retainage).

b. **100%** of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **95%** of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.1.E of the General Conditions, and less **such amounts as Engineer shall determine as** the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.3 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.6 of the General Conditions.

ARTICLE 8—CONTRACT DOCUMENTS

7.1 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.

2. Specifications (not attached but incorporated by reference) consisting of **[164]** sections with each sheet bearing the following general title: **CITY OF CUMMING – PWPF – PHASE 2 CLEARWELL IMPROVEMENTS**

3. Drawings (not attached but incorporated by reference) consisting of **[166]** sheets with each sheet bearing the following general title: **CITY OF CUMMING – PWPF – PHASE 2 CLEARWELL IMPROVEMENTS**

4. Addenda

Addendum Number	Addendum Date
#1	
#2	
#3	

5. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
   a. Work Change Directives.
   c. Change Orders.
   d. Field Orders.

B. The Contract Documents listed in Paragraph 6.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 6.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 9—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.1 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.

4. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

5. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

6. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

7. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

8. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

9. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

8.2 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 7.02:

1. "Corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the Proposal process or in the Contract execution.

2. "Fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the Proposal process or the execution of the Contract to the detriment of Owner, (b) to establish Proposal or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

3. “Collusive practice” means a scheme or arrangement between two or more Proposers, with or without the knowledge of Owner, a purpose of which is to establish Proposal prices at artificial, non-competitive levels; and

4. “Coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the Proposal process or affect the execution of the Contract.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____, 2026, (which is the Effective Date of the Contract).

Owner:

City of Cumming
(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: **Phil Higgins**
(typed or printed)

Title: **City Administrator**
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

City of Cumming
100 E. Main Street
Cumming, GA 30040

Designated Representative:

Name: Jonathon W. Heard
(typed or printed)

Title: Director of Utilities
(typed or printed)

Address: 100 East Main Street
Cumming, GA 30040

Phone: 770-781-2020

Email: Jon.heard@cityofcumming.net

Contractor:

_____
(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

*(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address:

Phone: _____

Email: _____

License No.: _____
(where applicable)

State: Georgia

END OF SECTION 00 52 13

SECTION 00 55 00
NOTICE TO PROCEED

Owner: **CITY OF CUMMING**

Engineer: **PRIME ENGINEERING, INC.**

Contractor: _____

Project: **PWPF – PHASE 2 CLEARWELL IMPROVEMENTS**

Effective Date of Contract: _____

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on **_____, 2026,** pursuant to Paragraph 4.1 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The number of days to achieve Substantial Completion is **425 days** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **_____, 2026 .**

Owner: **CITY OF CUMMING**

By *(signature)*: _____

Name *(printed)*: **PHIL HIGGINS**

Title: **CITY ADMINISTRATOR**

Date Issued: _____

ACCEPTANCE OF NOTICE

Receipt of the above **NOTICE TO PROCEED** is hereby acknowledged by

Contractor: _____

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Date Issued: _____

SECTION 00 61 14
PERFORMANCE BOND

Contractor	**Surety**
Name:	Name:
Address *(Contractor's principal place of business)*:	Address *(Principal place of business)*:
Owner	**Contract**
Name: **City of Cumming**	Description: **City of Cumming – PWPF – Phase 2 Clearwell Improvements**
Mailing address: **100 Main Street Cumming, GA 30040**	Contract Price: **$**
	Effective Date of Contract: **_____, 2026**

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:
    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default.
    3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and
    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.
4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.
5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract.
    5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors.
    5.3. Obtain proposals or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or
    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
        5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or
        5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

    7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract.

    7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

    7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows: _____
_____

SECTION 00 61 15
PAYMENT BOND

Contractor Name: Address *(Contractor's principal place of business)*:	**Surety** Name: Address *(Principal place of business)*:
Owner Name: **City of Cumming** Mailing address *(principal place of business)*: **100 Main Street** **Cumming, GA 30040**	**Contract** Description: **City of Cumming – PWPF – Phase 2 Clearwell Improvements** Contract Price: **$** Effective Date of Contract: **_____, 2026**

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____ *(Full formal name of Contractor)*	_____ *(Full formal name of Surety) (corporate seal)*
By: _____ *(Signature)*	By: _____ *(Signature)(Attach Power of Attorney)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____
Attest: _____ *(Signature)*	Attest: _____ *(Signature)*
Name: _____ *(Printed or typed)*	Name: _____ *(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond will arise after the following:
    5.1. Claimants who do not have a direct contract with the Contractor
        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).
    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
    7.2. Pay or arrange for payment of any undisputed amounts.

7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

16.1. *Claim*—A written statement by the Claimant including at a minimum:

16.1.1. The name of the Claimant;

16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

16.1.4. A brief description of the labor, materials, or equipment furnished;

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows:_____

_____

SECTION 00 62 15
CERTIFICATE OF OWNER'S ATTORNEY

I, the undersigned, Kevin Tallant, the duly authorized and acting legal representative of the City of Cumming, Georgia, (the "City") do hereby certify as follows:

I have examined the attached Contract Documents and the manner of execution thereof by the City, and I am of the opinion that each of the aforesaid agreements are adequate and have been duly executed by the proper parties on behalf of the City; that said representative(s) has full power and authority to execute said agreements on behalf of the City, and that the foregoing agreements constitute valid and legally binding obligations upon the City in accordance with terms, conditions, and provisions thereof.

By: _____

Date: _____

SECTION 00 62 16
CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	NAIC #
INSURED	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	[X] **COMMERCIAL GENERAL LIABILITY** [ ] CLAIMS-MADE [X] OCCUR [ ] GEN'L AGGREGATE LIMIT APPLIES PER: [ ] POLICY [X] PROJ [ ] LOC [ ] OTHER:						EACH OCCURRENCE	$
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$
							MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
							PRODUCTS - COMP/OP AGG	$
								$
A	**AUTOMOBILE LIABILITY** [X] ANY AUTO [ ] OWNED AUTOS ONLY [ ] SCHEDULED AUTOS [ ] HIRED AUTOS ONLY [ ] NON-OWNED AUTOS ONLY [ ]						COMBINED SINGLE LIMIT (Ea accident)	$
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
							Medical payments	$
B	[X] **UMBRELLA LIAB** [X] OCCUR **EXCESS LIAB** [ ] CLAIMS-MADE [ ] DED [X] RETENTION $						EACH OCCURRENCE	$
							AGGREGATE	$
								$
C	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [ ] **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below						[X] PER STATUTE [ ] OTH-ER	
							E.L. EACH ACCIDENT	$
							E.L. DISEASE - EA EMPLOYEE	$
							E.L. DISEASE - POLICY LIMIT	$
D	Professional Liability						Per Claim Annual Aggregate	

CERTIFICATE HOLDER

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

SECTION 00 63 63
CHANGE ORDER FORM

OWNER: **CITY OF CUMMING**

ENGINEER: **PRIME ENGINEERING, INC.**

CONTRACTOR: _____

PROJECT: **PWPF – PHASE 2 CLEARWELL IMPROVEMENTS**

ORIGINAL AGREEMENT DATE: _____

ORIGINAL CONTRACT AMOUNT: _____

CHANGE ORDER DATE: _____

_____is hereby directed to comply with the following additions and deductions to the above referenced Contract Plans and Specifications.

1. **Add/Deduct: Brief Description**

   Itemized Detail $ _____

   Itemized Detail $ _____

   Itemized Detail $ _____

   $ _____

2. **Add/Deduct: Brief Description**

   Itemized Detail $ _____

   Itemized Detail $ _____

   Itemized Detail $ _____

   $ _____

TOTAL CHANGE ORDER NO. __ **$ _____**

The **Contract Amount** shall be **increased / decreased** by $_____, from $_____ to $_____. The **completion date** is **changed / unchanged**.

This Document will become a supplement to the Contract Documents and all provisions will apply hereto.

Requested By: OWNER
CITY OF CUMMING

_____ Date: _____
Phil Higgins
City Administrator

Recommended By: ENGINEER
PRIME ENGINEERING, INC.

_____ Date: _____
Robert R. MacPherson, P.E.
Vice President

Accepted By: CONTRACTOR

_____ Date: _____

SECTION 00 65 19
FINAL LIEN WAIVER

TO: **CITY OF CUMMING, CUMMING, GEORGIA**

FROM: _____

RE: AGREEMENT BETWEEN THE CITY OF CUMMING, GEORGIA AND _____ (CONTRACTOR) DATED _____ FOR CONSTRUCTION OF THE **PWPF – PHASE 2 CLEARWELL IMPROVEMENTS** PROJECT.

I HEREBY CERTIFY THAT ALL SUPPLIERS OF MATERIALS, EQUIPMENT AND SERVICES, SUBCONTRACTORS, MECHANICS AND LABORERS EMPLOYED BY _____ (CONTRACTOR) OR ANY OF ITS SUBCONTRACTORS IN FORSYTH COUNTY, GEORGIA HAVE BEEN PAID AND SATISFIED IN FULL AS OF _____, 20___, AND THAT THERE ARE NO OUTSTANDING OBLIGATIONS OR CLAIMS OF ANY KIND FOR THE PAYMENT OF WHICH THE CITY OF CUMMING, GEORGIA ON THE ABOVE-NAMED PROJECT MIGHT BE LIABLE, OR SUBJECT TO, IN ANY LAWFUL PROCEEDING AT LAW OR IN EQUITY.

THE UNDERSIGNED IS AUTHORIZED BY CONTRACTOR TO EXECUTE THIS DOCUMENT ON CONTRACTOR'S BEHALF AND HAS PERSONAL KNOWLEDGE OF THE FACTS HEREIN STATED.

_____ _____
BY: AUTHORIZED OFFICER OR AGENT DATE

_____
TITLE OF AUTHORIZED OFFICER OR AGENT

_____
PRINTED NAME OF AUTHORIZED OFFICER OR AGENT

SUBSCRIBED AND SWORN BEFORE ME ON THIS

_____DAY OF_____, 20_____

_____

NOTARY PUBLIC
MY COMMISSION EXPIRES: _____

SECTION 00 72 00
GENERAL CONDITIONS

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.1 Defined Terms

A. Wherever used in the Proposal Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. Addenda—Written or graphic instruments issued prior to the opening of Proposals which clarify, correct, or change the Proposal Requirements or the proposed Contract Documents.

2. Agreement—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. Application for Payment—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. Proposal—The offer of a Proposer submitted on the prescribed form setting forth the prices for the Work to be performed.

5. Proposer—An individual or entity that submits a Proposal to Owner.

6. Proposal Documents—The Proposal Requirements, the proposed Contract Documents, and all Addenda.

7. Proposal Requirements—The Advertisement or invitation to proposal, Instructions to Proposers, Proposal Bond or other Proposal security, if any, the Proposal Form, and the Proposal with any attachments.

8. Change Order—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. Change Proposal—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. Claim

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal;

seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.1.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. Constituent of Concern—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. Contract—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. Contract Documents—Those items so designated in the Agreement, and which together comprise the Contract.

14. Contract Price—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. Contract Times—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. Contractor—The individual or entity with which Owner has contracted for performance of the Work.

17. Cost of the Work—See Paragraph 13.1 for definition.

18. Drawings—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. Effective Date of the Contract—The date, indicated in the Agreement, on which the Contract becomes effective.

20. Electronic Document—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. Electronic Means—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook,

Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. Engineer—The individual or entity named as such in the Agreement.
23. Field Order—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
24. Hazardous Environmental Condition—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.
    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. Laws and Regulations; Laws or Regulations—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. Liens—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. Milestone—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.
28. Notice of Award—The written notice by Owner to a Proposer of Owner's acceptance of the Proposal.
29. Notice to Proceed—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
30. Owner—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
31. Progress Schedule—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.
32. Project—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
33. Resident Project Representative—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. Samples—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
35. Schedule of Submittals—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.
36. Schedule of Values—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
37. Shop Drawings—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.
38. Site—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.
39. Specifications—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
40. Subcontractor—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
41. Submittal—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. Substantial Completion—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.
43. Successful Proposer—The Proposer to which the Owner makes an award of contract.
44. Supplementary Conditions—The part of the Contract that amends or supplements these General Conditions.
45. Supplier—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. Technical Data

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.3, 5.4, and 5.6, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. Underground Facilities—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. Unit Price Work—Work to be paid for on the basis of unit prices.

49. Work—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. Work Change Directive—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.2 Terminology

A. The words and terms discussed in Paragraphs 1.2.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Proposal Requirements or Contract Documents, have the indicated meaning.

B. Intent of Certain Terms or Adjectives: The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the

design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. Day: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. Defective: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents.

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.3 or Paragraph 15.4).

E. Furnish, Install, Perform, Provide

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Contract Price or Contract Times: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.1 Delivery of Performance and Payment Bonds; Evidence of Insurance

A. Performance and Payment Bonds: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. Evidence of Contractor's Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. Evidence of Owner's Insurance: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.2 Copies of Documents

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.3 Before Starting Construction

A. Preliminary Schedules: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract.

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.4 Preconstruction Conference; Designation of Authorized Representatives

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.3.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.5 Acceptance of Schedules

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.3.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.6 Electronic Transmittals

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.1 Intent

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.2 Reference Standards

A. Standards Specifications, Codes, Laws and Regulations

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Proposals (or on the Effective Date of the Contract if there were no Proposals), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.3 Reporting and Resolving Discrepancies

A. Reporting Discrepancies

1. Contractor's Verification of Figures and Field Measurements: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.1.

2. Contractor's Review of Contract Documents: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity,

or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.1.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. Resolving Discrepancies

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.4 Requirements of the Contract Documents

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs) or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.5 Reuse of Documents

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.5 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.1 Commencement of Contract Times; Notice to Proceed

A. The Contract Times w15.1

ill commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Proposal opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.2 Starting the Work

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.3 Reference Points

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.4 Progress Schedule

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.5 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.5) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.4, or as Owner and Contractor may otherwise agree in writing.

4.5 Delays in Contractor's Progress

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes.

2. Abnormal weather conditions.

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment.

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work.

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work.

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.7.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.5.D and 4.5.E.

G. Paragraph 8.3 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.1 Availability of Lands

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.2 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate

corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. Removal of Debris During Performance of the Work: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. Cleaning: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. Loading of Structures: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.3 Subsurface and Physical Conditions

A. Reports and Drawings: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. Underground Facilities: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.5, and not in the drawings referred to in Paragraph 5.3.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. Reliance by Contractor on Technical Data: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.1.A.46.b.

D. Limitations of Other Data and Documents: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their

officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto.
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings.
3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.4 Differing Subsurface or Physical Conditions

A. Notice by Contractor: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.3 is materially inaccurate.
2. is of such a nature as to require a change in the Drawings or Specifications.
3. differs materially from that shown or indicated in the Contract Documents; or
4. is of an unusual nature and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents.

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. Engineer's Review: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.4.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. Owner's Statement to Contractor Regarding Site Condition: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. Early Resumption of Work: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. Possible Price and Times Adjustments

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work, subject, however, to the following:

   a. Such condition must fall within any one or more of the categories described in Paragraph 5.4.A.

   b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.3; and,

   c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.5.D and 4.5.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

   a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Proposal or becoming bound under a negotiated contract, or otherwise.

   b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Proposal Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

   c. Contractor failed to give the written notice required by Paragraph 5.4.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. Underground Facilities; Hazardous Environmental Conditions: Paragraph 5.5 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.6 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.3 and 5.4 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.5 Underground Facilities

A. Contractor's Responsibilities: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following is included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site.

2. complying with applicable state and local utility damage prevention Laws and Regulations.

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction.

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. Notice by Contractor: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. Engineer's Review: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings or was not shown or indicated with reasonable accuracy.

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary, issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question.

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. Owner's Statement to Contractor Regarding Underground Facility: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. Early Resumption of Work: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and

conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. Possible Price and Times Adjustments

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work, subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.3.

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.5.D and 4.5.E; and

c. Contractor gave the notice required in Paragraph 5.5.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.5.F.

5.6 Hazardous Environmental Conditions at Site

A. Reports and Drawings: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the

Technical Data as defined in Paragraph 1.1.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto.
2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.6.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.5.D, 4.5.E, 11.7, and 11.8.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.6.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.6.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.6.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.3, 5.4, and 5.5 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.1 Performance, Payment, and Other Bonds

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.8, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Proposal Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or Regulations,

and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.2 Insurance—General Provisions

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may

block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.3 Contractor's Insurance

A. Required Insurance: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. General Provisions: The policies of insurance required by this Paragraph 6.3 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.6.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract.

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. Additional Insureds: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions.

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds.

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.4 Builder's Risk and Other Property Insurance

A. Builder's Risk: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. Property Insurance for Facilities of Owner Where Work Will Occur: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.6.D.

C. Property Insurance for Substantially Complete Facilities: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.6.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. Partial Occupancy or Use by Owner: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.4, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. Insurance of Other Property; Additional Insurance: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.4, it may do so at Contractor's expense.

6.5 Property Losses; Subrogation

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.4 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners,

employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.4, after Substantial Completion pursuant to Paragraph 15.3, or after final payment pursuant to Paragraph 15.6, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.5 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.6 Receipt and Application of Property Insurance Proceeds

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.4 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.4 shall maintain such proceeds in a segregated account and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise

required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.1 Contractor's Means and Methods of Construction

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.2 Supervision and Superintendence

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.3 Labor; Working Hours

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.4 Services, Materials, and Equipment

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary

facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.5 "Or Equals"

A. Contractor's Request; Governing Criteria: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

   a. in the exercise of reasonable judgment Engineer determines that the proposed item:

      1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics.

      2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole.

      3) has a proven record of performance and availability of responsive service; and

      4) is not objectionable to Owner.

   b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

      1) there will be no increase in cost to the Owner or increase in Contract Times; and

      2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. Contractor's Expense: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. Engineer's Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete

and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. Effect of Engineer's Determination: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding and may not be reversed through an appeal under any provision of the Contract.

E. Treatment as a Substitution Request: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.6.

7.6 Substitutes

A. Contractor's Request; Governing Criteria: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.6.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

a. will certify that the proposed substitute item will:

1) perform adequately the functions and achieve the results called for by the general design.

2) be similar in substance to the item specified; and

3) be suited to the same use as the item specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times.

2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

1) all variations of the proposed substitute item from the item specified; and

2) available engineering, sales, maintenance, repair, and replacement services.

d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. Engineer's Evaluation and Determination: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. Special Guarantee: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. Reimbursement of Engineer's Cost: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. Contractor's Expense: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. Effect of Engineer's Determination: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.6.D, by timely submittal of a Change Proposal.

7.7 Concerning Subcontractors and Suppliers

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Proposal or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the proposal process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.8 Patent Fees and Royalties

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.9 Permits

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Proposal (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 Taxes

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 Laws and Regulations

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.3.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Proposal (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 Record Documents

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.13 Safety and Protection

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work.

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.6.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 Hazard Communication Programs

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 Submittals

A. Shop Drawing and Sample Requirements

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents.

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal.

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. Submittal Procedures for Shop Drawings and Samples: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. Shop Drawings

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. Samples

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. Engineer's Review of Shop Drawings and Samples

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.3. 2.4, and 2.5.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 Contractor's General Warranty and Guarantee

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.8. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.8:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective: and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.1.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer.

2. Recommendation by Engineer or payment by Owner of any progress or final payment.

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner.

4. Use or occupancy of the Work or any part thereof by Owner.

5. Any review and approval of a Shop Drawing or Sample submittal.
6. The issuance of a notice of acceptability by Engineer.
7. The end of the correction period established in Paragraph 15.8.
8. Any inspection, test, or approval by others; or
9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 Indemnification

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 Delegation of Professional Design Services

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or

other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19.
2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.1 Other Work

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.5.C.3.

8.2 Coordination

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors.

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.3 Legal Relationships

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Proposal or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.5.D and 4.5.E.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.3.B.
2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.1 Communications to Contractor

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.2 Replacement of Engineer

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.3 Furnish Data

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.4 Pay When Due

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.5 Lands and Easements; Reports, Tests, and Drawings

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.1.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.3.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.6 Insurance

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.7 Change Orders

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.8 Inspections, Tests, and Approvals

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.2.B.

9.9 Limitations on Owner's Responsibilities

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 Undisclosed Hazardous Environmental Condition

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.6.

9.11 Evidence of Financial Arrangements

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 Safety Programs

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.1 Owner's Representative

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.2 Visits to Site

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is

proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.7. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.3 Resident Project Representative

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.7.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.4 Engineer's Authority

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.5 Determinations for Unit Price Work

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.3.

10.6 Decisions on Requirements of Contract Documents and Acceptability of Work

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.7 Limitations on Engineer's Authority and Responsibilities

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.6.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.7 also apply to the Resident Project Representative, if any.

10.8 Compliance with Safety Program

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.1 Amending and Supplementing the Contract

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.2 Change Orders

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive.

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off.

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.5, (b) required because of Owner's acceptance of defective Work under Paragraph 14.4 or Owner's correction of defective Work under Paragraph 14.7, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.3.B, resolving the impact of a Work Change Directive; Paragraph 11.9, concerning Change Proposals; Article 12, Claims; Paragraph 13.2.D, final adjustments resulting from allowances; Paragraph 13.3.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.2.A, it will be deemed to be of full force and effect, as if fully executed.

11.3 Work Change Directives

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.7 regarding change of Contract Price.

B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.4 Field Orders

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.5 Owner-Authorized Changes in the Work

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price, or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.5 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.6 Unauthorized Changes in the Work

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.5.C.2.

11.7 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.9. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.3);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.7.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.1) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.7.C).

C. Contractor's Fee: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

    a. For costs incurred under Paragraphs 13.1.B.1 and 13.1.B.2, the Contractor's fee will be 15 percent.

    b. For costs incurred under Paragraph 13.1.B.3, the Contractor's fee will be 5 percent.

    c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.7.C.2.a and 11.7.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.1.B.1 and 13.1.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

    d. No fee will be payable on the basis of costs itemized under Paragraphs 13.1.B.4, 13.1.B.5, and 13.1.C.

    e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

    f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.1.B (specifically, payroll costs, Paragraph 13.1.B.1; incorporated materials and equipment costs, Paragraph 13.1.B.2; Subcontract costs, Paragraph 13.1.B.3; special consultants costs, Paragraph 13.1.B.4; and other costs, Paragraph 13.1.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.7.C.2.a through 11.7.C.2.e, inclusive.

11.8 Change of Contract Times

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.9. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.5.

11.9 Change Proposals

A. Purpose and Content: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. Change Proposal Procedures

1. Submittal: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. Supporting Data: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

   a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.5.D and 4.5.E.

   b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

   The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. Engineer's Initial Review: Engineer will advise Owner regarding the Change Proposal and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. Engineer's Full Review and Action on the Change Proposal: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. Binding Decision: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. Resolution of Certain Change Proposals: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. Post-Completion: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.6.B.

11.10 Notification to Surety

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's

responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.1 Claims

A. Claims Process: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals.

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents.

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.7, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.6.B.

B. Submittal of Claim: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. Review and Resolution: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. Mediation

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. Partial Approval: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. Denial of Claim: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. Final and Binding Results: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.1 Cost of the Work

A. Purposes for Determination of Cost of the Work: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.1 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. Costs Included: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.1.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive proposals from subcontractors acceptable to Owner and Contractor and shall deliver such proposals to Owner, which will then determine, with the advice of Engineer, which proposals, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.1.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.
5. Other costs consisting of the following:
    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
        1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.
    c. Construction Equipment Rental
        1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
        2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
        3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs

will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.4), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. Costs Excluded: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.1.B.1 or specifically covered by Paragraph 13.1.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.1.B.

D. Contractor's Fee

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.7.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.7.C.2.

E. Documentation and Audit: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.2 Allowances

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. Cash Allowances: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. Owner's Contingency Allowance: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.3 Unit Price Work

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Proposals and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. Adjustments in Unit Price

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.1 Access to Work

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.2 Tests, Inspections, and Approvals

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.5.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner.

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work.

3. by manufacturers of equipment furnished under the Contract Documents.

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.3 Defective Work

A. Contractor's Obligation: It is Contractor's obligation to assure that the Work is not defective.

B. Engineer's Authority: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. Notice of Defects: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. Correction, or Removal and Replacement: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. Preservation of Warranties: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. Costs and Damages: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.4 Acceptance of Defective Work

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.5 Uncovering Work

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.6 Owner May Stop the Work

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.7 Owner May Correct Defective Work

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.7, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.7 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.7.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.1 Progress Payments

A. Basis for Progress Payments: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.3. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. Applications for Payments

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. Review of Applications

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated.

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.3, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

   a. to supervise, direct, or control the Work.

   b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto.

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work.

   d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

   e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.1.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, requiring correction or replacement.

   b. the Contract Price has been reduced by Change Orders.

   c. Owner has been required to correct defective Work in accordance with Paragraph 14.7 or has accepted defective Work pursuant to Paragraph 14.4.

   d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

   e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. Payment Becomes Due

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. Reductions in Payment by Owner

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

   a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the

Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement.

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site.

c. Contractor has failed to provide and maintain required bonds or insurance.

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible.

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities.

f. The Work is defective, requiring correction or replacement.

g. Owner has been required to correct defective Work in accordance with Paragraph 14.7 or has accepted defective Work pursuant to Paragraph 14.4.

h. The Contract Price has been reduced by Change Orders.

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause.

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work.

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.1.D.1 and subject to interest as provided in the Agreement.

15.2 Contractor's Warranty of Title

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.3 Substantial Completion

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that

Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.4 Partial Use or Occupancy

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner,

and Engineer will follow the procedures of Paragraph 15.3.A through 15.3.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.3 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.4 regarding builder's risk or other property insurance.

15.5 Final Inspection

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.6 Final Payment

A. Application for Payment

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents.

b. consent of the surety, if any, to final payment.

c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects or will so pass upon final payment.

d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.6.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other

indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. Engineer's Review of Final Application and Recommendation of Payment: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. Notice of Acceptability: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.7.

D. Completion of Work: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. Final Payment Becomes Due: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.7 Waiver of Claims

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim, appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim or appealed under the provisions of Article 17.

15.8 Correction Period

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect

Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas.
2. correct such defective Work.
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.1.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so, provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.1 Owner May Suspend Work

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.2 Owner May Terminate for Cause

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents.

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.2.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.2.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.2.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.1.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.2.B and 16.2.D.

16.3 Owner May Terminate for Convenience

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work.

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.4 Contractor May Stop Work or Terminate

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.3.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.1 Methods and Procedures

A. Disputes Subject to Final Resolution: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. Final Resolution of Disputes: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions.
2. agree with the other party to submit the dispute to another dispute resolution process; or
3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.1 Giving Notice

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business.
2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.2 Computation of Times

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.3 Cumulative Remedies

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.4 Limitation of Damages

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.5 No Waiver

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.6 Survival of Obligations

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.7 Controlling Law

A. This Contract is to be governed by the law of the state in which the Project is located.

18.8 Assignment of Contract

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.9 Successors and Assigns

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 Headings

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 00
SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.1 SUPPLEMENTARY CONDITIONS

A. The provisions of the Supplementary Conditions as described herein change, amend, or supplement the General Conditions and shall supersede any conflicting provisions of this CONTRACT. All provisions of the General Conditions which are not changed, amended, or supplemented, remain in full force.

1.2 INSURANCE

A. The CONTRACTOR shall purchase and maintain such insurance as will protect it from claims set forth below which may arise out of, or result from, the CONTRACTOR's execution of the WORK, whether such execution be by the CONTRACTOR, any SUBCONTRACTOR, or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

1. Claims under workmen's compensation, disability benefit and other similar employee benefit acts.

2. Claims for damages because of bodily injury, occupational sickness or disease, or death of employees.

3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than employees.

4. Claims for damages insured by usual personal injury liability coverage which are sustained (1) by any person as a result of an offense directly or indirectly related to the employment of such person by the CONTRACTOR, or (2) by any other person.

5. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting there from.

B. Evidence of Contractor’s Insurance: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

C. Evidence of Owner's Insurance: After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

1.3 CONFLICTS

A. The General Conditions of the Contract shall govern in the event of any conflict with any other provisions of the Contract Documents unless notice to the contrary shall have been issued by the Owner. In the event of conflict, the Supplementary General Conditions control over the General Conditions and the Contract controls over the Supplementary and General Conditions. The Engineer has no authority to amend the General Conditions, orally or in writing, either expressly or by implication.

B. The following principles shall govern the settlement of disputes which may arise over conflicts in the Contract Documents: (a) as between figures given on drawings and the scaled measurements, the figures shall govern; (b) as between large-scale drawings and small-scale drawings, the larger scale shall govern; (c) as between drawings and specifications, the requirements of the specifications shall govern; and (d) as between the contract and the specifications, the requirements of the contract shall govern. Conflicts noted shall be reported to the Design Professional.

1.4 ACCEPTANCE AND FINAL PAYMENT

A. When the work provided for under this CONTRACT shall have been completed by the Contractor, and all parts thereof have been approved by the ENGINEER according to the CONTRACT, the ENGINEER shall, within ten (10) days unless otherwise provided, make final inspection and advise the Contractor as to preparing a final estimate, showing the value of work as soon as the necessary measurements and computations can be made, all prior certificates or estimates upon which payments have been being made approximated only, and subject to correction in the final payment. The amount of the final estimates, less any sums that may have been deducted or retained under the provisions of this CONTRACT, will be paid to the Contractor within sixty (60) days after approval by the Engineer, provided that the Contractor has properly maintained and operated the PROJECT as specified under these Specifications, and provided, that it has furnished to the Owner a sworn affidavit in form satisfactory to Owner's attorney to the effect that all bills are paid and no suits are pending in connection with the work done or labor and material furnished under this CONTRACT.

1.5 SUBSURFACE AND PHYSICAL CONDITIONS

A. All excavation is considered unclassified excavation.

END OF SECTION 00 73 00

SECTION 01 00 00 GENERAL

REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.1	Change of Contract Price; Change of Contract Time; Delays
1.2	References
1.3	Definitions
1.4	System Description
1.5	Contract Drawings
1.6	Schedules
1.7	Or Equals
1.8	Submittals
3.1	Access
3.2	Aid to the Injured
3.3	Buildings and Shanties
3.4	Cleaning
3.5	Cleaning and Crowning of Streets
3.6	Cleaning Surfaces
3.7	Contractor’s Office
3.8	Dimensions and Elevations
3.9	Emergency Response
3.10	Environmental Contamination
3.11	Existing Irrigation and Sprinkler Systems
3.12	Existing Utilities
3.13	Inspections
3.14	Insufficiency of Safety Precautions
3.15	Intoxicating Liquors
3.16	Landscape Protection
3.17	Lighting
3.18	Means and Methods
3.19	Measures and Weights
3.20	Mill and Shop Tests and Inspection
3.21	Monuments and Landmarks
3.22	Obstructions Encountered
3.23	Overtime Work
3.24	Ownership of Materials
3.25	Painting and Coatings
3.26	Power
3.27	Protecting Existing Buildings and Structures

3.28 Protection
3.29 Record Drawings
3.30 Roadway Right-of-Way, Working Facilities, and Easements
3.31 Safety
3.32 Sales Tax
3.33 Sanitary Measures.
3.34 Schedules
3.35 Shoring, Formwork, and Temporary Structures
3.36 Site Video
3.37 Sound Attenuation
3.38 Storage
3.39 Temporary Heat
3.40 Use of Facilities
3.41 Use of Streets
3.42 Utility Relocations or Modifications
3.43 Water Supply
3.44 Work in Inclement Weather

1.1 CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIME; DELAYS

1.1.1 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice, submitted by the party making the Claim, to the other party to the Contract.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved; or

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, by a lump sum value fixed by the Owner, or by unit price values fixed by the Owner (which may include an allowance for overhead and profit); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and where the methods under Paragraph 1.1.1.B.2. are not selected by the Owner, on the basis of the Cost of the Work plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 1.1.1.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:
1. A mutually acceptable fixed fee.

1.1.2 Change of Contract Times

A. The Contract Time may only be changed by a Change Order. Any Claim for an adjustment in the Contract Time shall be based on written notice submitted by the party making the Claim to the other party to the Contract.

B. Any adjustment of the Contract Time covered by a Change Order or any Claim for an adjustment in the Contract Time will be determined in accordance with the provisions of this Paragraph 1.1.1.

1.1.3 Delays

A. Where Contractor is prevented from completing any part of the Work within the Contract Time due to delay beyond the control of Contractor, the Contract Time *may* be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.2.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work, fires, floods, epidemics, abnormal weather conditions, quarantine restrictions, strikes, freight embargoes, acts of war (declared or not declared), or acts of God.

B. If Owner, or other contractors, or utility owners performing other work for Owner, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Time, *or both*. Contractor's entitlement to an adjustment of the Contract Time is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Time.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts, or failures to act, of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor *may* be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Time. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Time for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control

of Contractor.

1.2 REFERENCES

A. 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 documents before it was discontinued shall apply.

B. 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.

1.3 DEFINITIONS

A. Whenever the following abbreviations are used, they shall refer to and designate: "ACI" - American Concrete Institute
"AISC" - American Institute of Steel Construction
"ANSI" - American National Standards Institute
"ASME" - American Society of Mechanical Engineers "ASTM" - American Society for Testing and Materials "AWWA" - American Water Works Association
"CPW" – City of Cumming Public Works Department
"CU" – City of Cumming Utility Department
"GDOT" – Georgia Department of Transportation

1.4 SYSTEM DESCRIPTION

A. Performance Requirements

The Work shall be comprised of and for the construction of CUMMING UTILITIES infrastructure as identified in the Bid Schedule, including but not limited to, safety, installation, connections, sterilizing, testing, and fabrication with any and all appurtenances in accordance with the Contract Documents, complete and fully operational in compliance with federal, state, county, and local codes and regulations, standards, and specifications as applicable at the time of bid unless otherwise directed in writing by CUMMING UTILITIES.

1.5 CONTRACT DRAWINGS

A. Existing conditions shown on the Contract Drawings were derived from the best available information at the time and preparation of the Contract Documents and do not purport to be completely correct. The Contractor is therefore directed to perform any and all field surveys that are deemed necessary to satisfy the Contractor to the actual surface and sub-surface conditions prior to submitting his/her bid, upon which

his/her bid shall be based.

B. The Work proposed, its connections, routing, and design intent was based on the available information of the existing conditions. The Contractor shall field verify the nature and extent of the Work proposed prior to ordering any materials. No payment shall be authorized for materials not retained as part of CUMMING UTILITIES facilities and its appurtenances.

C. Additionally, CUMMING UTILITIES reserves the right to require deviations from the Contract during construction where such deviations are deemed necessary to provide for future connections or to provide flexibility in the maintenance and operation of the system and increase the efficiency and reliability of service to its customers. Deviations will be addressed using contract unit prices. If this cannot be accomplished see Article 10 of the General Conditions.

D. The Contractor shall maintain, on site, one (1) complete set of Contract Documents throughout the course of the Work and make available upon request by CUMMING UTILITIES.

1.6 SCHEDULES

A. Contractor shall prepare, furnish, distribute, and periodically update the Project Progress Schedule and Schedule of Submittals, as specified herein. Contractor shall also prepare and furnish a Schedule of Values, as specified herein.

B. Acceptance of the Contractor's Project Progress Schedule, Schedule of Submittals, and Schedule of Values, and revisions thereto, shall in no way relieve Contractor of any duties and obligations under the Agreement. Such approval is limited to the format of the schedule, and does not in any way indicate approval of, or concurrence with, the Contractor's means, methods, and ability to carry out the Work.

C. Submit a monthly update of the Project Progress Schedule and Schedule of Submittals with each request for payment.

D. Failure of the Contractor to meet the schedule submission milestones will result in withholding of monthly payments, until deliverables associated with the milestones are received. Payments will be withheld should the Contractor fail to deliver acceptable schedules within thirty (30) days after date of Notice to Proceed.

1.7 OR EQUALS

A. For the purposes of these Contract Documents, "or equal" item(s) shall be defined as:

1. A product or manufacturer offered as a replacement to a specified product or manufacturer where the term "or equal" is included after the list of acceptable manufacturers in the Specification.

B. An item which is offered where no specific product, manufacturer, means, methods, technique, sequence, or procedure of construction is specified or shown on the Drawings, shall not be considered a replacement, and shall be at the option of the Contractor, subject to the provisions in the Contract Documents for that item.

C. For products specified only by a referenced standard, the Contractor may select any product by any manufacturer, which meets the requirements of the Specifications,

unless indicated otherwise in the Contract Documents.

D. If the manufacturer is named on the Drawings, or in the Specifications as an acceptable manufacturer, products of that manufacturer meeting all requirements of the Specifications and Drawings are acceptable.

E. Whenever the design is based on a specific product of a particular manufacturer, that manufacturer will be shown on the Drawings and/or listed in the list of approved manufacturers in the Specifications. Any Contractor intending to furnish products other than the listed acceptable manufacturer(s) shall:

1. Verify that the item being furnished will fit in the space allowed, perform the same function(s), and have the same capabilities as the item specified,

2. Include in the item price the cost of all accessory items, which may be required by the "or equal" product,

3. Include the cost of any architectural, structural, mechanical, piping, electrical, instrumentation, or other modifications required, and

4. Include the cost of required additional work by the Engineer, if any to accommodate the item.

F. Approval of the Engineer and Owner of an "or equal" item as an acceptable manufacturer, is dependent on determination that the product offered:

1. Is essentially equal in function, performance, quality of manufacture, ease of maintenance, reliability, service life, availability of local technical support, and other criteria to that on which the design is based, and

2. Will require no major modifications to structures, electrical systems, control systems, or piping systems.

G. "Or equal" items will be considered only if the term "or equal" is included after the list of acceptable manufacturers in the Specification.

H. The Contractor shall submit shop drawings on the "or equal" item for the Engineer's review in accordance with Specification Section 01 33 00 Submittal Procedures.

I. The cost of Engineer's and Owner's factory inspection, reference project tour, or mill inspection, required to evaluate the acceptance of the "or equal" product shall be borne by the Contractor.

1.8 SUBMITTALS

A. Specified submittals shall be to the Engineer, and submitted by the Contractor only, (i.e.

NOT subcontractors, vendors, suppliers, etc.).

B. Each submittal, with variations from the requirements of the Contract Documents, shall make specific mention of such variations. Those declared variations found acceptable by the
Engineer or CUMMING UTILITIES shall require the Contractor to take suitable action for the proper installation in accordance with the Contract Documents. Variation not declared or suitable action not taken by the Contractor shall not relieve Contractor of error or the responsibility for executing the Work, and cost for remedial actions deemed necessary by the Engineer or CUMMING UTILITIES.

PART 2 – PRODUCTS – (NOT USED)

PART 3 – EXECUTION

3.1 ACCESS

A. The Contractor shall enable and facilitate access to all parts of the Work to CUMMING UTILITIES and third parties to inspect, certify, or observe when required by law; or to those who require reasonable access to the Work by reason of specific contractual relationship to the Work.

3.2 AID TO THE INJURED

A. The Contractor shall furnish, maintain, and make ready and available for immediate use, first aid to the injured with standing arrangements for the immediate removal, transport, and hospital treatment of any personnel who may be injured on the Work, as required by federal, state, county and local laws, codes and regulations.

3.3 BUILDINGS AND SHANTIES

A. No provision shall be allowed for the housing of men/women employed for the Work on land owned or leased by the County, unless in writing a permit is secured from CUMMING UTILITIES. Should permission be asked and granted, the Contractor shall comply with all regulations regarding the construction and maintenance of such buildings.

3.4 CLEANING

A. With completion of the Work, the Contractor shall return the surface conditions of the work area to pre-work status, unless where otherwise specified in the Contract Documents. The finished surface Work shall leave the grounds in a neat and approved condition, including but not limited to, the removal of material, debris, equipment, structures, and the Contractor's office.

B. Contractor shall terminate all temporary utilities as applicable or as required by the

Contract Documents. Contractor shall also clean out all drains, pipes, inlets, and miscellaneous and appurtenant structures of debris from his/her operations.

3.5 CLEANING AND CROWNING OF STREETS

A. As Work progresses and before the Work herein specified is accepted, the Contractor shall, upon notice from CUMMING UTILITIES, thoroughly clean all streets, roads, sidewalks, and lawns free from all debris and dirt accumulating from the construction, shall open all gutters so that free drainage may be had, and on unpaved streets and roads, shall completely crown the roadway within the limits of the herein specified Work.

3.6 CLEANING SURFACES

A. Contact surfaces between existing and new Work shall be free from debris, dirt, grease, or foreign matter to the extent of wire brushing and washing, and such surface preparation as recommended by the manufacturer or directed by CUMMING UTILITIES. The cost for cleaning shall be included in the Prices Bid and stipulated for the various items of the bid.

3.7 CONTRACTOR'S OFFICE

A. Facilities are not required to be on the project site. The Contractor may provide adequate indoor facilities for conducting project meetings; and at a minimum shall be equipped with power, water, lighting, heating ventilation and air conditioning, and a meeting area with table and chairs. If in the opinion of CUMMING UTILITIES, the location of the facility is not convenient to project personnel, CUMMING UTILITIES may provide suitable facilities for project meetings.

3.8 DIMENSIONS AND ELEVATIONS

A. In the Contract Documents, figured dimensions shall take precedence over scaled dimensions, detailed drawings shall take precedence over general drawings, and elevations and slopes shall be as indicated on the Drawings, or as directed by the Engineer.

3.9 EMERGENCY RESPONSE

A. The Contractor shall respond within four (4) hours to any emergency that may arise in connection with the Work on a twenty-four (24) hour per day, seven (7) days per week basis. Should County maintenance forces be called upon by the County to rectify a problem created by the Contractor, the Contractor shall be responsible for all costs incurred by the County, plus twenty-five (25) percent, with a minimum charge of one hundred (100) dollars per occurrence. This charge is subject to change depending upon the severity of the emergency and will be determined by Forsyth County.

3.10 ENVIRONMENTAL CONTAMINATION

A. Precautions against property endangerment and/or damages from water, sewage, seepage, storm, stormwater, and flood flows shall be active during the course of

Work. Cost for precautions shall be included in the Prices Bid and stipulated for the items of Work.

3.11 EXISTING IRRIGATION AND SPRINKLER SYSTEMS

A. The Contractor shall be responsible for restoring the soundness to any portion of an existing irrigation or sprinkler system disturbed and/or damaged by the Work. No compensation shall be made for this Work.

3.12 EXISTING UTILITIES

A. Existing utilities shall be maintained, except when a utility or a utility feature requires moving. In such circumstances, the Contractor shall notify the utility before any such Work is started for approval. In the event that the utility grants approval for such movement that results in damage, it shall be repaired by the authorities having control of the same, and the expense of said repairs shall be paid by the Contractor or deducted from the monies which are due or to become due to said Contractor. No underground or overhead facilities encountered shall be disturbed without proper authority and then only in such manner as said owner may prescribe and approve.

B. Should it become necessary to change the position, or permanently or temporarily remove part of a utility in order to clear the structure being built or to permit the Contractor to use a particular method of construction, the Contractor shall notify CUMMING UTILITIES of the location and circumstances and shall cease work if necessary, until satisfactory arrangements have been made by the Owners of the said utility to properly care for or relocate the same as necessary to permit the Work to proceed as specified. No claims for damages shall be allowed the Contractor on account of any delay occasioned thereby. The entire cost of the changes or temporary or permanent removal of such utilities shall be borne by the Contractor and the cost thereof shall be included in the Prices Bid and stipulated for the various Items of the Bid.

C. Nothing contained herein shall relieve the Contractor of doing such Work at his cost and expense as is specifically included in the Contract Documents.

D. Anything contained herein shall not relieve the Contractor of his obligation to support and protect all pipes, conduits, and other structures which may be encountered during the construction of Work, and to make good all damages done to such pipes, conduits, and other structures, as provided in this specification. Any such damages must be repaired without delay and the cost of such repairs must be borne by the Contractor.

3.13 INSPECTIONS

A. CUMMING UTILITIES shall schedule a pre-construction meeting with the Contractor a minimum of 24- hours prior to construction. During construction the CUMMING UTILITIES Inspector shall be the lead person for witnessing construction including, but not limited to, taps, cores, bores, wet cut-ins, flow diversions, shutdowns,

testing, chlorination, sampling and work that may be required or determined necessary by the Engineer. Should existing conditions necessitate a change or cost to the Contract Documents, the CUMMING UTILITIES Project Manager shall be notified for approval prior to proceeding.

B. The CUMMING UTILITIES Inspector shall review and approve quantities of unit items installed and/or materials stored in the Work by the Contractor prior to Contractor's submittal for payment to CUMMING UTILITIES Project Manager. Failure to do so may result in delays in processing payments.

C. Upon notification by the Contractor, CUMMING UTILITIES shall perform an inspection of the finished surface features and conditions for acceptance of the Work. Should discrepancies exist, the Contractor shall make restorations as directed, until acceptance is granted by CUMMING UTILITIES, upon which final payment shall be made for the Work.

D. Contractor shall pay for second inspections, if so required by the County.

3.14 INSUFFICIENCY OF SAFETY PRECAUTIONS

A. If at any time, in the opinion of the County, the Work is not properly instituted or maintained and is not in accordance with federal, state, county and local laws, codes and regulations, the Contractor shall execute immediate measures to bring into compliance unsatisfactory surroundings. In the event that the Contractor is not readily available at the Work to be notified of the insufficiency of safety precautions, then the County may elect to institute or restore such Work to a state deemed safe. Such actions by the County shall in no way release the Contractor from judiciary duty specified. Costs to correct safety precautions shall be at the Contractor's expense.

3.15 INTOXICATING LIQUORS

A. The Contractor shall neither permit nor suffer the introduction or use of intoxicating substances, such as but not limited to, alcohol or illegal drugs upon or about the Work jobsite.

3.16 LANDSCAPE PROTECTION

A. Landscaping, such as but not limited to, ornamental trees, shrubbery, hedges, flower beds, decorative berms, decorative rocks, ponds, timbers, and their appurtenances shall not be removed or disturbed without approval from CUMMING UTILITIES. However, should it be required to remove or disturb such items, the Contractor shall seek approval no later than 72 hours in advance of conflict. If and when approval is granted by CUMMING UTILITIES, the Contractor shall take the proper precautions to preserve, protect, and reestablish such items along the line of or contiguous to the Work. All landscaping shall be restored to the same or better general conditions as existed prior to commencement of the Work. If deemed by CUMMING UTILITIES to be damaged, each item damaged shall be replaced with the same type and like size. Cost for removal and relocation shall be considered as having been included in the Prices Bid and stipulated for the various items of Work.

Cost for restitution shall be borne by the Contractor.

3.17 LIGHTING

A. Except for acts of nature, the Work shall be secured by such means to prevent loss to health, limb, and property. Adequate lighting shall be provided and maintained during periods of Overtime Work, from one-half (½) hour before sunset to one-half (½) hour after sunrise. Contractor shall provide adequate lighting for safety and performance of construction operations and provide the necessary safety and other facilities required for work during normal working hours and for work at night.

3.18 MEANS AND METHODS

A. Unless otherwise expressly provided in the Contract Documents, the means and methods of construction shall be such as the Contractor may choose. However, CUMMING UTILITIES maintains the right to reject or alter the Contractor's proposed means and methods, which shall not produce finished Work in accordance with the terms of the Contract, or to CUMMING UTILITIES right as administrator of the construction to direct the Contractor to more stringent means or methods.

B. If determined by CUMMING UTILITIES that the Contractor's work methods, features, and/or equipment appears to be unsafe, insufficient, or improper, CUMMING UTILITIES may order the Contractor to improve their safety, sufficiency, and/or character, whereby the Contractor shall conform to such orders; but should CUMMING UTILITIES not demand any increase of such safety precautions, insufficiency, inadequacy or any improvement shall not release the Contractor from his obligation to secure the work methods, safety precautions, work features, and/or equipment for the safe conduct and quality of work specified, and shall not constitute a cause of action for damages.

C. The Contractor shall have the right to deny access to the Work during construction, except to

CUMMING UTILITIES and third parties to inspect, certify, or observe when required by law; or to those who require reasonable access to the Work by reason of specific contractual relationship to the Work.

3.19 MEASURES AND WEIGHTS

A. Whenever so requested as deemed necessary by CUMMING UTILITIES, the Contractor shall provide accurate scales, adequate equipment, and the necessary assistance for weighing and/or measuring materials for the installed Work as specified. It is understood and agreed that a "ton" shall mean the short ton of two thousand (2,000) pounds.

3.20 MILL AND SHOP TESTS AND INSPECTION

A. Where the specifications call for mill or shop tests, the Contractor shall furnish triplicate copies of attested certificates signed by a duly authorized representative of the manufacturer, showing details of quality or performance sufficient to demonstrate compliance with the Contract Documents. Inspection of materials shall be made as

required by these specifications.

3.21 MONUMENTS AND LANDMARKS

A. Monuments or landmarks shall not be damaged or removed by the Contractor or any of his/her employees without the written consent of CUMMING UTILITIES. Any monument or landmark so removed shall be replaced by CUMMING UTILITIES at the expense of the Contractor. The cost thereof shall be retained from the monies due or to become due the Contractor under this agreement.

3.22 OBSTRUCTION ENCOUNTERED

A. The giving of this information upon the Work Assignment Contract Drawings shall not relieve the Contractor of his obligation to support and protect all pipes, conduits, and other structures which may be encountered during the construction of Work, and to make good all damages done to such pipes, conduits, and other structures, as provided in this Specification. The Contractor shall locate obstructions ahead of the Work. Should the Contractor determine that the existing information is not correct, and an obstruction shall be encountered, he/she shall immediately contact CUMMING UTILITIES.

3.23 OVERTIME WORK

A. It is the intent of the contract that the Contractor provide sufficient work force at all times during normal working hours and days of each week to complete the Work without resort to overtime work. The definition of normal working hours and days is 8:00am to 5:00pm, Monday through Friday, Forsyth County-recognized legal holidays excepted, during a consecutive period as agreed upon in the area of the Work, not counting the lunch period; and the definition of normal work week is the aggregate of the five (5) consecutive eight (8) hour days, Monday through Friday inclusive, maximum, the same holidays excepted.

B. Night work or work on Saturdays, Sundays, or Forsyth County-recognized legal holidays, shall not be permitted, unless it is absolutely necessary, and then only with the **written permission** of CUMMING UTILITIES.

C. Should the Contractor, for his convenience, request permission to work overtime or to work on Saturdays, Sundays, or trade recognized legal holidays in the area of the Work, the County shall have the right to deduct sufficient sums from the monies due the Contractor to cover payment of additional salaries for the CUMMING UTILITIES personnel as are normally employed on the Work.

D. Should it become necessary for Work to be accomplished at the direction of CUMMING UTILITIES for the convenience and/or requirement of the CUMMING UTILITIES outside of normal working hours, then full inspection and engineering shall be provided at no additional cost to the Contractor during those hours.

E. During periods of overtime work, the Contractor shall provide the necessary facilities required for work during normal working hours and for work at night. The Contractor shall be in readiness in time of emergency even nights, Saturdays,

Sundays, and holidays at no cost to the County.

3.24 OWNERSHIP OF MATERIALS

A. Existing material removed that shall not be relocated or reused in the Work shall be moved off site within 48 hours, becoming the property of the Contractor. The cost for such Work shall be as stipulated by the Prices Bid, for the various items of the Work.

B. Existing material recovered that shall be relocated or reused in the Work shall be refurbished or renovated as required, unless otherwise directed by CUMMING UTILITIES.

C. Existing material removed shall be disposed of in a manner approved by CUMMING UTILITIES at the Contractor's expense.

D. New material not installed in the Work shall be moved offsite and remain the property of the Contractor. Only material that is installed by the Contractor will be paid for. However, the Contractor may submit pay applications for stored material in accordance with Section 14.02 of the General Conditions.

E. All manhole covers, salvaged fire hydrants and any other material bearing the name of Forsyth County shall be returned to CUMMING UTILITIES.

3.25 PAINTING AND COATINGS

A. It is the intention of these specifications that metal permanently installed in the Work shall be protected by a durable coating of paint, or other approved material, and that all such metal surfaces not buried in the earth or masonry shall be left clean and well painted at the completion of the Contract, and in accordance with detailed requirements as may hereinafter be set forth.

3.26 POWER

A. The Contractor shall make his own arrangements for power. No payment shall be made for cost of obtaining power. The cost for power shall be as stipulated by the Prices Bid, for the various items of the Work.

3.27 PROTECTING EXISTING BUILDINGS AND STRUCTURES

The Contractor shall take the necessary precautions to protect, including but not limited to, buildings, bridges, structures, and substantial walls or fences which may be encountered or endangered in the execution of the Work, not otherwise provided for, shall repair and make good any damages caused by reason of his operations and restore such property to its state before the damages. Existing walls and fences that are removed due to the execution of the Work shall be replaced by the Contractor and, where required or directed by CUMMING UTILITIES, temporary fencing shall be installed by the Contractor. No payment shall be made for said Work or material.

3.28 PROTECTION

A. The Contractor shall furnish and maintain satisfactory protection to the Work against injury by weather, flooding, or breakage thereby permitting all Work to be left in a

perfect condition at the completion of the Work.

3.29 RECORD DRAWINGS

A. The Contractor shall be furnished one set of Contract Drawings for the purpose of recording information on the as installed Work, as specified in Section 01 78 39 Project Record Documents. The information shall be correct and presented on the Drawings and returned to CUMMING UTILITIES for acceptance.

B. The Contractor shall provide Georgia State Plane GPS coordinates for all appurtenances (fire hydrants, manholes, junction boxes, valves (new or existing), etc.) associated with the work.

3.30 ROADWAY RIGHT-OF-WAY, WORKING FACILITIES, AND EASEMENTS

A. Work within the limits of private property and rights-of-way, shall be done in conformity with all applicable permits and agreements with the County and the owners of such private property, easements, or rights-of-way. Whether or not such a condition be part of the agreement, care shall be taken to avoid injury to the premises entered, which premises shall be left in a neat and orderly condition by the removal of rubbish and the grading of surplus materials, and the restoration of said private property to the same or better general conditions as at the time of entry for Work to be performed under this contract. The Contractor shall not enter any easement without first confirming with CUMMING UTILITIES that such easement is fully executed.

B. The Contractor shall not (except after consent from the proper parties), enter or occupy with labor, tools, or equipment on any land outside the rights-of-way or property of the County.

C. The Contractor shall be allowed use of the site designated for construction as necessary for the Work. However, existing access to properties shall be maintained or adequate access provided during the course of the Work. Cost for access shall be included in the Prices Bid and stipulated for the various items of the Work to be done under this contract.

D. Work that shall be performed on private property or easements that requires granted access beyond the established road right-of-way shall be done in conformity with all permits and agreements between Forsyth County and property owners. Should the Contractor desire or require additional space outside the limits of Work, he/she must arrange for such space with property and easement owners at his/her own expense. Legal binding agreements for such additional space must be in writing and a copy filed with CUMMING UTILITIES, prior to accessing such lands. In such agreements, care shall be taken to avoid injury to the premises entered and shall be left in a neat and orderly condition as existed at the time of entry for Work.

E. When working on easements, the Contractor shall install Tree Save Barriers along all boundaries of the work area, unless otherwise specifically directed by CUMMING UTILITIES, prior to any Work. Work premises shall be left in a neat and orderly condition by the removal of rubbish, debris, and the grading of surplus materials and the restoration of said private property to the same general conditions as existed at

the time of entry for Work.

3.31 SAFETY

A. Unless otherwise specified, all federal, state and county regulations shall be maintained during the course of the Work.

3.32 SALES TAX

A. The Contractor shall furnish CUMMING UTILITIES with certified copies of paid invoices or their equivalent proof covering sales tax paid on items which CUMMING UTILITIES is eligible for tax refund; none of which shall be refunded or credited to the Contractor.

3.33 SANITARY MEASURES

A. Sanitary conveniences shall be employed prior to beginning the Work in sufficient number, in such manner and in such places as shall satisfy CUMMING UTILITIES. Such sanitary conveniences shall

be operated and maintained in such a manner as to remove harmful effects to personnel or environment. All persons connected with the Work are obliged to use the conveniences provided and shall in no way violate these provisions. Violations shall result in an immediate dismissal of the employee and removal from the Work. Only upon written consent by CUMMING UTILITIES shall the violator regain access to the Work. Sanitary conveniences shall be maintained during the Work and in compliance with the local Health Department and CUMMING UTILITIES. When possible, sanitary conveniences shall be placed in locations that least impact public view. Upon completion of the Work, the Contractor shall remove sanitary conveniences without deleterious effect.

3.34 SCHEDULES

A. The Project Progress Schedule shall be plotted on a minimum eleven-inch by seventeen-inch (11” x 17”) size sheets with the flow of activities from left to right. Printing shall be in color and suitable for half-size reproduction. No lettering or numbering shall be less than one- eighth-inch (1/8”) in height for capital letters and numbers. The critical path shall be clearly marked and readily identifiable.

B. The Project Progress Schedule shall be a Critical Path Method (CPM) Network Diagram, and include the following:

1. Furnish an updated diagram with all activities and restraints. This includes providing an “As-Built” Schedule with completion dates for all key monthly completion and delivery dates,
2. Provide updated Project Progress Schedule graphics in color showing progress- to-date and completion schedule. The critical path shall be clearly identified,
3. A legend clearly identifying each symbol used,
4. Be prepared in the form of a time-scaled CPM network,

5. Group activities by facility and major area of work. The identification number of the individual activities shall be coded such to provide the grouping,

6. Be prepared in chronological order of the beginning of each item of work,

7. Have a horizontal time scale based on calendar days and identify the Monday of each week,

8. Show the order and interdependencies of the activities and the sequence in which the work is to be accomplished as planned by the Contractor. The diagram shall show how the start of a given activity is dependent upon the completion of the preceding activities, and how its completion restricts the start of following activities. Float need not be shown on the network diagram,

9. Show all activities relating to the construction of the work, and include the following information related to the activities:

    a. Activity number

    b. Activity description

    c. Percent complete

    d. Estimated duration, in working days, of each activity

    e. Start date
    f. Finish date

10. Show all planned facility shutdowns, including temporary relocations, temporary bypasses, and transitions from existing to temporary, temporary to new, and the like.

    a. For each anticipated shutdown included in the schedule, submit within thirty (30) days prior to the planned shutdown, a description of the shutdown, duration, anticipated start and completion dates, related preparation work, and related temporary facilities to be provided.

11. Show adverse weather days on the critical path.

    a. The number of adverse weather days per month shown on the critical path of the schedule shall not be less than the mean number of days for that particular month, in which precipitation meets or exceeds 1/10-inch, liquid measure.

    b. The mean number of days in which the precipitation meets or exceeds 1/10-inch, liquid measure, will be based upon a thirty (30) year average of precipitation recorded and described by the National Oceanic and Atmospheric Administration (NOAA).

    c. The total number of adverse weather days shall be monitored and agreed to monthly by Contractor, Engineer, and Owner. The Project Progress Schedule shall be updated to reflect the accrual of adverse weather days agreed to and enacted by a Contract Time

extension.

12. Show the following for specified submittals of Shop Drawings, product data, samples, and materials:
    a. Submittal date,
    b. Review period, based on fourteen (14) calendar day review period,
    c. Fabrication duration,
    d. Delivery dates.
13. Show the following events and milestones in addition to construction activities:
    a. Notice to Proceed,
    b. Milestones,
    c. Schedule of Submittals
    d. Operational Testing (including air testing, chlorination, CCTV, etc.)
    e. Owner coordination
    f. Notification Periods
    g. Coordination with separate contracts/contractors
    h. Owner activities impacting the Work.

C. The Project Progress Schedule update shall coincide with the end of the pay period. The update shall be used to create the monthly payment application request. No monthly payment request will be processed unless the Project Progress Schedule is updated and submitted to the Engineer.

D. The Schedule of Values shall be of the following form:
1. Type schedule on eight and one-half –inch by eleven-inch (8½" x 11") white paper,
2. Contractor's standard forms and automated printouts may be used,
3. Identify Schedule of Values information with:
    a. Title of Project
    b. Project Location
    c. Purchase Order Number
    d. Name of Engineer Firm
    e. Name and Address of Contractor
    f. Bid Number (BL)
    g. Date of Submission

E. The Schedule of Values shall list the installed value of the component parts of the Work in sufficient detail to serve as a basis for computing values for progress payments during construction. Breakdown shall be by utility, then by CSI Format, for ease of

field verification of quantities completed.

F. For Schedule of Values, follow the Bid Form as the format for listing component items. Identify each item with number and title of the respective major section of the Specifications.

G. For each major line item, list sub values of major products or operations under the item.

H. For the various portions of the Work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

2. For items on which progress payments will be requested for stored materials, breakdown the value into:

a. The delivered and unloaded cost of the materials, with taxes paid. Owner shall require invoices for proof of purchase.

b. The total installed value, including Contractor's overhead and profit, less the value of stored material item a. above.

3.35 SHORING, FORMWORK, AND TEMPORARY STRUCTURES

A. The Contractor shall take full responsibility including the hiring of a practicing licensed professional engineer that may be needed for the adequacy and safety throughout erection, use and removal of all temporary Work such as shoring and supports during all phases of the Work, formwork, and supports for concrete, temporary protection, and structures of all kinds.

3.36 SITE VIDEO

A. Prior to the Work, the Contractor shall perform and supply CUMMING UTILITIES a thoroughly detailed video of the worksite and its contiguous area. The video shall be of such quality as to view and establish existing conditions in detail and used to render a decision where no other documentation is available. Site videos made from a moving vehicle will not be accepted.

3.37 SOUND ATTENUATION

A. The Contractor shall, during the course of the Work, comply with Forsyth County Noise Ordinance unless CUMMING UTILITIES enforces a stricter standard.

B. Work operations, machinery, equipment, and material handling shall be performed in such a manner as to avoid and eliminate unnecessary noise. Noise deemed unacceptable by the County shall be immediately terminated.

3.38 STORAGE

A. Materials, equipment, tools, and machinery required for the Work shall be neatly and compactly piled in such a manner as to cause the least inconvenience to property owners and traffic. Storage shall be in areas approved by CUMMING UTILITIES. Fire hydrants, water and gas shut-off boxes, underground power and telephone line manholes shall, at all times, be kept free and unobstructed, and shall be left uncovered

by such materials.

3.39 TEMPORARY HEAT

A. The Contractor shall supply temporary heat for such period of time and at such temperature as needed for the proper protection and execution of the Work. No cost shall be paid for temporary heat.

3.40 USE OF FACILITIES

A. The County shall have the right or grant permits to connect any conduit, pipeline, or structure with the Work and its appurtenances at any time before the Work is accepted. The Contractor shall not interfere or be granted compensation for such Work.

3.41 USE OF STREETS

A. Access: During the progress of the Work, the Contractor shall make ample provisions for both vehicular and foot traffic on public roadways except during periods of road closures approved by Forsyth County, and shall indemnify and save harmless Forsyth County from any expense whatsoever due to the Work. The Contractor shall provide, but not limited to, free access to all driveways, fire hydrants, water, and gas valves located along the line of Work. Gutters and waterways must be kept open or other provisions made for the removal of stormwater.

Street intersections may not be blocked, except for one-half (½) the roadway at any given time, and the Contractor shall lay and maintain temporary driveways, bridges, and crossings, such as in the opinion of CUMMING UTILITIES are necessary to reasonably accommodate the public.

B. Traffic Control: Adequate signs, barricades, and lights, in accordance with the standards of GDOT, necessary to protect the public shall be provided.

To direct traffic, flagger or Forsyth County Police Officer shall be employed continuously during periods when only one-way traffic can be maintained, or when equipment is operated back and forth across the pavement areas.

Roadway disturbances shall not be left unfilled overnight, except in emergencies, and in such cases adequate precautions shall be exercised to protect traffic.

C. Procedural Rules: Work in roads shall be in accordance with the rules and regulations of the controlling agency.

In the event of the Contractor's failure to comply with these provisions, CUMMING UTILITIES may cause the same to be done, and shall deduct the cost of such Work from any monies due or to become due the Contractor under this agreement, but the performance of such Work by CUMMING UTILITIES or at its instance, shall serve in no way to release the Contractor from his general or particular liability for the safety of the public or of the Work.

3.42 UTILITY RELOCATIONS OR MODIFICATIONS

A. Should, in the course of the Work, a need arises to relocate or modify a portion of CUMMING UTILITIES existing piping system, the Contractor shall immediately

notify CUMMING UTILITIES for approval to proceed with such Work in accordance with the Contract Documents, or as directed by CUMMING UTILITIES. Removal of the existing piping system shall include, but not be limited to, the removal of its bulkheads, thrust restraints, piping appurtenances, concrete, and/or masonry that was exposed by excavation in part or whole, except for tie-rods beyond the limits of trenching. Without exception, any part of an existing restraint system relevant to the remaining existing piping system shall remain and be supplemented with additional restraint to maintain an unimpaired piping system. The cost for such Work shall be as stipulated by the Prices Bid, for the various items of the Work.

3.43 WATER SUPPLY

A. In the vicinity of the Work, CUMMING UTILITIES shall make available water required to execute the Work. The Contractor shall be responsible for the retrieval, transport, and delivery of all water with all means to protect and maintain the integrity of CUMMING UTILITIES water system at his/her cost in accordance with all applicable rules and regulations. When water is required for the Work, the Contractor shall obtain a hydrant water meter from CUMMING UTILITIES Customer Service, at no up-front cost to the Contractor. The Contractor shall notify CUMMING UTILITIES of all project water usage by providing meter reads to the Project Inspector by the first business day of the month for project tracking purposes. If the hydrant meter is kept for 6 months, the Contractor will be contacted via email to bring the meter on a specified date, to CUMMING UTILITIES warehouse for recalibration testing.

3.44 WORK IN INCLEMENT WEATHER

A. The Contractor shall take into account historical weather conditions and potential difficulties that may be encountered for completing the Work demonstrated in the work schedule. Contractor shall provide adequate protection against unfavorable weather to the satisfaction of CUMMING UTILITIES. Weather shall not be grounds for contract extension of available workdays unless, such should be most adverse, and reasonable effort to perform the Work is exercised, and affected construction activities lie on the critical path of the current, approved Project Progress Schedule.

B. The attachment listed below, following “End of Section 01 00 00” is a part of this Specification.

1. Weather Delay Monthly Report

END OF SECTION 01 00 00

WEATHER DELAY MONTHLY REPORT

Month and Year Reported Below	Project Number and Name

Day of	Mark "X" if Work delayed by this				
	Precip	Temp	Wind	Dryout	Specific Description of Delay Condition and Construction Activity Affected
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					

(a) Total Weather Delays This Month
(b) Standard Baseline Days for Average Climatic Range this Month

Claimable Days this Month = (a) - (b)

SECTION 01 11 10

GEOTECHNICAL INFORMATION

PART 1 – GENERAL

1.1 SCOPE

A. The following geotechnical report document is available for review in the appendix of these contract documents:

Report of Subsurface Exploration and Geotechnical Engineering Evaluation
Preliminary Subsurface Investigation Report (February and March 2026)

Prepared by:
GeoSystems Engineering, Inc.

Interpretations, evaluations, and conclusions as to the nature of the geotechnical materials, the difficulties of making and maintaining the required excavations, and the difficulties of doing other work affected by geotechnical conditions shall be the sole responsibility of the Contractor. At no additional cost to the Owner, the Contractor may conduct, with Owner's approval, other investigations and tests it deems appropriate.

PART 2 – MATERIALS

(NOT USED)

PART 3 – EXECUTION

(NOT USED)

END OF SECTION 01 11 10

SECTION 01 22 15
MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 SUMMARY

A. This section defines the bid items of Work listed on the Bid Form and defines 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, 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, actually used and installed quantities of each bid item shall be measured in the field and certified by the Engineer and/or CUMMING UTILITIES 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. Work not listed in the Bid Schedule, including but not limited to costs for related work and appurtenances which are required and/or implied by the General Provisions, Technical Specifications, Special Provisions, and Drawings, and are not listed as a separate bid item but are necessary to complete the project shall be included in the appropriate bid item, or items within the proposal

D. The Contractor shall assist and fully cooperate with CUMMING UTILITIES to determine proper measurement and payment for each item providing complete and reasonable backup documentation as requested by CUMMING UTILITIES to substantiate payment due.

1.2 PAY ITEMS

The following items 1 through 9 comprise the Base Bid ; Work Item 10 comprises the Owner directed work, as listed on the Bid Form:

1 CLEARWELL

1.1 6 MG Clearwell Installation

MEASUREMENT: This item covers all work necessary for the construction of the six million gallon Clearwell. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Document or as directed by CUMMING UTILITIES. Work under this bid item shall include, but not be limited to:

- Demolition of existing conditions if necessary
- Clearing, grubbing, and grading
- Excavation, hauling, and compacting

- Gound Improvement
- Construction the six million gallon Clearwell
- Instrumentation
- Commissioning

PAYMENT: Payment for construction of the 6MG Clearwell will be made at the lump sum price named in the Bid Schedule under the associated section. The price for the bid shall constitute full compensation for providing all labor, materials, equipment, supplies, testing and appurtenant work necessary to the work complete in place as shown and specified in the Contract Documents or as directed by CUMMING UTILITIES. No additional compensation will be allowed

1.2 1 MG Clearwell Work

MEASUREMENT: This item covers all work necessary for the modifications to the existing 1 million gallon Clearwell. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents or as directed by CUMMING UTILITIES. Work under this bid item shall include, but not be limited to:

- Modification to existing utility piping coming to and from the Clearwell
- New piping installations
- Existing Pump Modifications
- New Pump Installation
- Controls & Instrumentation associated with he above
- Commissioning

PAYMENT: Payment for construction of the 6MG Clearwell will be made at the lump sum price named in the Bid Schedule under the associated section. The price for the bid shall constitute full compensation for providing all labor, materials, equipment, supplies, testing and appurtenant work necessary to the work complete in place as shown and specified in the Contract Documents or as directed by CUMMING UTILITIES. No additional compensation will be allowed

1.3 2 MG Clearwell Work

MEASUREMENT: This item covers all work necessary for the modifications to the existing 1 million gallon Clearwell. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents or as directed by CUMMING UTILITIES. Work under this bid item shall include, but not be limited to:

- Modification to existing utility piping coming to and from the Clearwell
- New piping installations
- Existing vent modifications
- Existing Pump Modifications
- New Pump Installation
- Controls & Instrumentation associated with the above
- Commissioning

PAYMENT: Payment for construction of the 6MG Clearwell will be made at the lump sum price named in the Bid Schedule under the associated section. The price for the bid shall constitute full compensation for providing all labor, materials, equipment, supplies, testing and appurtenant work necessary to the work complete in place as shown and specified in the Contract Documents or as directed by CUMMING UTILITIES. No additional compensation will be allowed

2 WATER UTILITIES PIPING (UNIT PRICE)

MEASUREMENT: Utility piping shall be measured from the exact beginning of the pipe to the end of the pipe run. No deductions shall be made for branches. The price shall be per linear foot (LF). Installation shall follow Project Specifications and Drawings. Include all work necessary or incidental to the construction of the water utility piping including but not limited to the following:

- Excavation
- Valve installation
- Piping
- Vaults or other precast structures
- Bedding
- Backfill
- Testing and Commissioning

PAYMENT: Utility piping will be paid for at the contract unit price per linear foot for pipe of type and size specified, completed in place (including bedding) per the applicable specifications and drawings.

3 STORM SEWER (UNIT PRICE)

MEASUREMENT: Storm sewer shall be measured from the exact beginning of the pipe to the end of the pipe run. No deductions shall be made for branches. The price shall be per linear foot (LF). Installation shall follow the Project Specifications and Drawings. Include all work necessary or incidental to the construction of the water utility piping including but not limited to the following:

- Excavation
- Precast, or Poured in Place Structures
- Bedding
- Backfill
- Flushing

PAYMENT: Storm Sewer Piping will be paid for at the contract unit price per linear foot of pipe type and size specified, completed in place (including bedding) per the applicable specifications and drawings.

4 SANITARY SEWER (UNIT PRICE)

MEASUREMENT: Sewer Piping shall be measured from the exact beginning of the pipe to the end of the pipe run. No deductions shall be made for branches. The price shall be per linear foot (LF). Installation shall follow the Project Specifications and Drawings. Include all work necessary or incidental to the construction of the water utility piping including but not limited to the following:

- Excavation
- Precast structures
- Bedding
- Backfill
- Testing and Commissioning

PAYMENT: Utility piping will be paid for at the contract unit price per linear foot for pipe of type and size specified, completed in place (including bedding) per the applicable specifications and drawings.

5 SITE AND MISC CONCRETE (LUMP SUM)

MEASUREMENT: This item covers all work necessary for the construction of the site concrete. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents. Work under this bid item shall include, but not be limited to:

- Retaining Walls
- Sidewalks
- Miscellaneous Concrete

PAYMENT: Site concrete and miscellaneous concrete will be paid for at the lump sum price bid for Site Concrete, complete in place. Weepholes, water tops, etc. will be included in the price. All backfilling will be in bid price for the retaining wall concrete. Payment will be made only for the quantities and dimensions as shown on drawings or applicable specifications.

6 PAVEMENT (LUMP SUM)

MEASUREMENT: This item covers all work necessary for paving as indicated on the Contract Documents. The lump sum price shall include providing all labor, materials, equipment, supplies, testing, and appurtenant work necessary or incidental to the construction of he project, complete in place and in accordance with the Contract Documents or as directed by CUMMING UTILITIES.

PAYMENT: Payment shall be the Lump sum price of asphalt pavement as specified or as directed by the Owner. Included shall be the costs of graded aggregate base, asphalt base, binder, asphalt surface, roadway striping, tack coat, milling, and all associated costs of work necessary for furnishing asphalt pavement.

7 EROSION AND SEDIMENT CONTROL (LUMP SUM)

MEASUREMENT: This item covers all work necessary for the construction of the Erosion and Sedimentation Control (suitably installed and maintained per the Manual for Erosion and Sediment Control of Georgia, Latest Edition) and other ancillary items associated with erosion and sedimentation control. It will include all costs associated with Erosion and Sediment Control Best Management Practices, including installation, maintenance and repair, and removal. All erosion and Sediment Control items shall be installed in accordance with the Contract Documents or as directed by CUMMING UTILITIES.

PAYMENT: Payment for Erosion and Sediment Control items will be made at the lump sum price named in the Bid Schedule under the associated section. The price for the bid shall constitute full compensation for providing all labor, materials, equipment, supplies, testing and appurtenant work necessary to the work complete in place as shown and specified in the Contract Documents or as directed by CUMMING UTILITIES. No additional compensation will be allowed

8 ELECTRICAL BUILDING (LUMP SUM)

MEASUREMENT: This item covers all work necessary for the construction of the electrical building. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents. Work under this bid item shall include, but not be limited to:

- Clearing, grubbing, and grading
- Ground Improvement
- Construction of electrical building
- Building Internals: HVAC, Electrical, Lighting
- Electrical Equipment and associated connections
    - Switch gear
    - MCC Sections
    - Transformers
    - Electrical Panels
- Controls Equipment and associated connections
    - I/O Panels
    - VFDs
    - Integration
    - Instrumentation
- Process Equipment
    - Air Compressor
- Commissioning
- Interfacing with Georgia Power emergency generator power feed.
- Interfacing and coordinating utility power supply such that power is available to commission proposed equipment and operate at the close of the project.

PAYMENT: Payment for construction of the Electrical Building will be made at the lump sum price named in the Bid Schedule under the associated section. The price for the bid shall constitute full compensation for providing all labor, materials, equipment, supplies, testing and appurtenant work necessary to the work complete in place as shown and specified in the Contract Documents or as directed by CUMMING UTILITIES. No additional compensation will be allowed

9 ELECTRICAL DISTRIBUTION WORK (UNIT PRICE)

9.1 Concrete Encased Duct Bank

MEASUREMENT: This item covers all work necessary for the construction of the concrete encased electrical duct bank. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents. Work under this bid item shall include, but not be limited to:

- Excavation
- Conduit duct, or Bank
- Vaults or other precast structures
- Bedding
- Backfill
- Damp Proofing
- Reinforcement Materials
- Testing and Commissioning

PAYMENT: Concrete Encased Duct Bank will be paid for at the lump sum price named in the Bid Schedule under the associated section, completed in place (including bedding) per the applicable specifications and drawings.

9.2 Electrical Conduit, Wiring, and Cabling

MEASUREMENT: This item covers all work necessary for the construction of conduit, wiring, cabling, and other conductors. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the Contract Documents. Work under this bid item shall include, but not be limited to:

- Conduit, duct, or raceways
- Conductors, Cables, and wiring
- Testing and Commissioning

PAYMENT: Conduit, Cables, Conductors, and wiring will be paid for at the lump sum price named in the Bid Schedule under the associated section, completed in place per the applicable specifications and drawings.

10 OWNER DIRETED WORK (LUMP SUM)

MEASUREMENT: This item covers all work necessary to complete owner directed work. The lump sum price shall include providing all labor, materials, equipment, supplies, testing and appurtenant work necessary or incidental to the construction of the project, complete in place and in accordance with the direction of CUMMING UTILITIES. Work under this bid item is currently unknown and shall be valued at **$1,000,000**

PAYMENT: The Price to be paid under this term shall be as directed by CUMMING UTILITIES.

END OF SECTION 01 22 15

SECTION 01 31 19
PROJECT MEETINGS

PART 1 – GENERAL

1.1 SCOPE:

A. Work under this Section includes all scheduling and administering of pre-construction and progress meetings as herein specified and necessary for the proper and complete performance of this Work.

B. Scheduling and Administration by Owner:
1. Prepare Agenda, with assistance from Engineer
2. Make physical arrangements for the meetings.
3. Preside at meetings.

A. Scheduling and Administration by Engineer:
1. Assist Owner with Agenda
2. Record minutes and include significant proceedings and decisions.
3. Distribute "Draft" meeting minutes for review/revision
4. Incorporate revisions and distribute Final copies of the minutes to participants.

1.2 PRE-CONSTRUCTION MEETING:

A. The Owner shall schedule the pre-construction conference prior to the issuance of the Notice to Proceed.

B. Representatives of the following parties are to be in attendance at the meeting:
1. Owner; including project manager, project inspector, Operations stakeholder(s)
2. Engineer
3. Designer (if different than Engineer)
4. Contractor's project staff including at a minimum: the project manager, site superintendent, quality/safety control coordinator, and subcontractor coordinator
5. Major subcontractors
6. Representative(s) of governmental or regulatory agencies, when appropriate.
7. Materials Testing Firm representative

C. The agenda for the preconstruction conference shall consist of the following as a minimum:
1. List of attendees, and introduction of each attendee and their respective project role.
2. Project Data to include Bid date, total Bid amount, Notice to Proceed Date, Substantial Completion date, and Final Completion Date.

3. List of project stakeholders and their contact information including email address and cell phone number.
4. Communication procedures and chain of communication for specified project components.
5. Distribute and discuss a list of major subcontractors and a tentative construction schedule, including County Holidays, and adverse weather days.
6. Critical work sequencing.
7. Pay request procedure including format, submittal, pay date, and retainage.
8. Procedures for maintaining record documents.
9. Discuss submittals to include, project schedules, requests for information, shop drawings, product data, samples, and project record drawings.
10. Processing of field decisions and Change Orders.
11. Work Times and Schedule.
12. Inspection of Work, testing, and laboratory work.
13. Safety and first aid procedures.
14. Permits, easements, and their acquisition status.
15. Blasting protocol.
16. Traffic control.
17. Housekeeping notes and procedures.

1.3 PROJECT PROGRESS MEETINGS:

A. Owner to schedule progress meetings monthly, or more frequently as directed by the Owner or Engineer.
B. Hold called meetings as the progress of the Work dictates.
C. The meetings shall be held at the location indicated by the Owner.
D. Representatives of the following parties are to be in attendance at the meetings:
   1. Owner, to include project manager, project inspector, and as conditions dictate, Operations stakeholder(s)
   2. Engineer, who shall prepare meeting minutes.
   3. Designer’s representative as appropriate
   4. Contractor’s project staff including at a minimum the project manager, site superintendent, quality control coordinator, and subcontractor coordinator
   5. Major subcontractors as pertinent to the agenda.
   6. Representatives of governmental or other regulatory agencies, as appropriate.
   7. Materials testing firm representative as pertinent to the agenda

E. The minimum agenda for progress meetings shall consist of the following:
   1. List of attendees
   2. Review and approve minutes of previous meeting.
   3. Contractor to supply updated Project Progress Schedule.
   4. Review work progress since last meeting.
   5. Review work progress planned for the next period.
   6. Status of Overall Project Schedule, identify problems which impede planned progress.
   7. Review Contractor's corrective measures and procedures to regain plan schedule.

8. Review submittal schedule.
9. Review budget status.
9. Review Request for Information process
10. Review Change Management items and status of individual Change documents.
11. Review Notices, Punch lists, and project coordination issues.
12. Note field observations, problems and decisions.
13. Review testing and quality control measures and associated issues.
14. Complete other current business.

1.4 SHUTDOWN COORDINATION MEETINGS:

A. One week minimum prior to significant planned shutdowns, Contractor shall arrange with Owner, and Owner shall convene a coordination meeting.

B. Meeting participants shall include Owner, Engineer, Designer, and Contractor, including involved subcontractors.

C. Meeting agenda shall include Contractor's review/presentation of detailed work plan and schedule, Owner input regarding facility operations, and all other pertinent coordination topics.

1.5 QUALITY CONTROL AND COORDINATION MEETINGS:

A. Scheduled by Engineer and coordinated with Owner, on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of Work and work of other contractors.

B. Attendees will include:

1. Owner, including project manager, project inspector, inspector coordinator, and as it pertains to the Work, Operations stakeholder(s)
2. Engineer
3. Designer (if different than Engineer)
4. Contractor's project staff including at a minimum: the project manager, site superintendent, quality/safety control coordinator, and subcontractor coordinator
5. Major subcontractors, as it pertains to the Work
6. Materials Testing Firm representative, as it pertains to the Work.

1.6 PRE-INSTALLATION MEETINGS:

A. When required in individual Specification Sections, convene at site prior to commencing Work of that section.
B. Require attendance of entities directly affecting, or affected by, Work of that Section.
C. Notify Engineer and Owner five (5) days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation,

preparation and installation or application procedures, and coordination with related Work and work of others.

1.7 FACILITY STARTUP MEETINGS:

A. Schedule and attend facility startup meetings for each system, facility, or group of facilities, as applicable.

B. Attendees will include:
1. Contractor's project staff including at a minimum the site superintendent.
2. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.
3. Engineer's representatives.
4. Owner's inspection personnel.
5. Others as required by Contract Documents.

1.8 OTHER MEETINGS:

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 31 19

SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

PART 1 – GENERAL

1.1 SCOPE

A. The Contractor shall furnish all equipment and labor materials required to provide the Owner with digital construction audio/video recordings of the Project.

B. Photos, electronic files, and audio/video recordings shall become the property of the Owner, and none of which shall be published without express permission of the Owner.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement and payment will be made for work under this section. All costs in connection with this work specified herein, is considered to be incidental to the Work.

1.3 PRE AND POST-CONSTRUCTION AUDIO/VIDEO RECORDINGS:

A. Prior to the beginning of any work, the Contractor shall make audio/video recordings of the work area to record existing conditions.

B. Following completion of the work, another recording shall be made showing the same areas and features as in the pre-construction recording.

C. All conditions which might later be subject to a disagreement shall be shown in sufficient detail to provide a basis for decisions.

D. The recordings shall include the date and time markings on the video. All videos shall be provided with an audio narration, stating a description of what is shown, structure, area, approximate station of the area shown, and street address and property owner where appropriate.

E. Audio/video recordings shall be made in standard definition DVD format and stored on a DVD optical disc. The quality and content shall be subject to the approval of the Owner and Engineer of Record.

F. The DVD disc shall bear a typed label containing the following information: Project title, date of recording, and project stations shown on the recording.

1.4 DISPUTES AND POTENTIAL CLAIMS

A. In the event a problem arises, or dispute occurs, which may result in a potential Claim, under General Conditions Article 10.05, and the problem or dispute can be illustrated by photographs and video recordings, the Contractor shall provide such photographs and video files.

1.5 SUBMITTALS:

A. Formats
1. Photo files shall be provided in jpeg format.
2. Audio/Video Recordings shall be provided in DVD format.

B. Audio/Video Recordings
1. The pre-construction recording shall be submitted prior to the first progress payment request.
2. The post-construction recording shall be submitted with the final payment request.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 32 33

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Contractor's Responsibilities
1.4	Engineer's Responsibilities
1.5	Request for Information (RFI)
1.6	Letter of Transmittal
2.1	General
2.2	Schedules
2.3	Request for Information
2.4	Shop Drawings
2.5	Operation and Maintenance Manuals
2.6	Record Drawing
3.1	General
3.2	Review Procedures
3.3	Schedules
3.4	Request for Information
3.5	Shop Drawings
3.6	Effect of Review of Contractor's Submittals
3.7	Cost for Review of Submittals

B. All materials and/or equipment provided to CUMMING UTILITIES shall require submittal to, and approval of, Engineer prior to releasing Contractor for ordering. Any items ordered and/or delivered without approved submittals may be rejected by CUMMING UTILITIES.

C. This section includes information and requirements for the submittal of documents during the course of work for, including but not limited to, schedules, shop drawings, product data, operation and maintenance manuals, requests for information, and record drawings as specified.

D. Submittals shall include, but not be limited to, manufacturers' information, catalog data, shop drawings, test procedures, test results, samples, calculations of equipment performance, equipment weight, fabrication, erection, mechanical accessories, materials installed, reinforcing steel, piping, details, and Work-related information. The Contractor shall furnish scaled drawings, or drawings of equivalent dimensions to ascertain information deemed necessary by the Engineer, including descriptive data, certificates, samples, tests, and any other instructions specifically required in the Contract Documents

or recommended by the manufacturer to demonstrate 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 REFERENCES

A. Drawings and general provisions of the Agreement, including General and Supplementary Conditions, and Division 1 Specification Sections, apply to this section.

1.3 CONTRACTOR'S RESPONSIBILITIES

A. Before starting construction, Contractor shall submit to the Engineer for timely review, a Preliminary Progress Schedule, and a Preliminary Schedule of Submittals; and shall submit to CUMMING UTILITIES for timely review, a Schedule of Values for all of the Work, in a format acceptable to CUMMING UTILITIES, per Specification Section 01 00 00 General Requirements.

B. After starting and during construction, Contractor shall submit to the Engineer for timely review, an updated Progress Schedule, and an updated Schedule of Submittals, per Specification Section 01 00 00 General Requirements.

C. The Contractor shall be responsible for the accuracy and completeness of information contained in each submittal assuring that the Work shall be done in accordance with the Contract Documents, unless a deviation has been approved. The Contractor shall verify that each feature of every product shall conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items being submitted in accordance with the Work. All extraneous materials shall be stricken out or removed. The Contractor shall coordinate submittals among his subcontractors and suppliers to meet the specified Work so that the Work shall not be delayed. No extension of time shall be allowed because of failure to properly schedule submittals. The Contractor shall certify on each submittal document that he/she has reviewed the submittal, verified field conditions, and complied with the Contract Documents.

D. The Contractor may authorize in writing to CUMMING UTILITIES that a material or equipment supplier may deal directly with CUMMING UTILITIES or its authorized representative. These dealings shall be limited to contract interpretations to clarify and expedite the Work.

E. If the information provided in a submittal indicates any deviation from the Contract requirements, the Contractor shall by written statement accompanying the submittal, advise the Engineer and CUMMING UTILITIES of any deviation and state the reasons for such.

F. It shall be the Contractor's responsibility to ensure there is no conflict with other submittals and to notify the Engineer and CUMMING UTILITIES in any case where the Contractor's submittal may concern work by another contractor, subcontractor, or CUMMING UTILITIES. The Contractor is solely responsible for the coordination of submittals by his subcontractors and shall verify that his subcontractors' submittals are complete in every way and meet the requirements of the Contract.

1.4 ENGINEER'S RESPONSIBILITIES

A. Submittal reviews shall be returned to the Contractor and copied to CUMMING UTILITIES, marked with one of the following, "No Exceptions Taken", "Note Markings", "Revise and Resubmit", "Rejected – See Remarks", or "Engineer's Review Not Required". Returned submittals marked with "Revise and Resubmit" or "Rejected – See Remarks" shall be re-submitted until an acceptable mark of "No Exceptions Taken" or "Note Markings" is granted. The contractor shall pay for any submittals requiring Engineer to review beyond the second submittal.

B. The approval of the Contractor's submittals shall not relieve the Contractor of responsibility for any error, or any obligation for accuracy of dimensions and details, or for agreement with and conformity to the Contract and Contract Documents, or the responsibility to fulfill the Contract as prescribed. Nor shall approval be considered approval of any deviation or conflict unless Engineer and CUMMING UTILITIES have been expressly advised of the same, or Engineer and CUMMING UTILITIES have expressly approved such deviation or conflict.

1.5 REQUEST FOR INFORMATION (RFI)

A. The Contractor shall submit in writing, a Request for Information (RFI) to the Engineer concerning all proposed substitutions and deviations to the Contract Documents, with the specified or associated parts. Such written requests shall be clearly marked with a numeric designation and should show a corresponding, concise, and lucid justification substantiating the benefits to CUMMING UTILITIES. RFIs are subject to rejection.

1.6 LETTER OF TRANSMITTAL

A. Transmittals shall be attached to each submittal with the following minimum requirements:

1. Transmittals written in pencil will be returned along with the submitted documents without review.

2. Transmittals shall be used for each submittal.

3. Transmittals shall be typed or written in ink announcing the project particulars, sender's and receivers' information, purpose for the submittal, a listing of items contained in the submittal with a detailed explanation attached to the cover of each submittal package.

PART 2 - SUBMITTALS

2.1 GENERAL

A. Submittals typically fall into one of five (5) general categories; "Schedules", "Request for Information (RFI)", "Shop Drawings", "Operation and Maintenance Manuals" and "Record Drawings". Unless otherwise specified, all submittals shall be considered product data.

2.2 SCHEDULES

A. The Contractor shall submit all requirements sufficiently in advance of construction requirements to allow ample time for the Contractor and Engineer to complete their responsibilities, as specified herein, without claim and or allowance by the Contractor for delays arising from his failure in this respect.

B. Preliminary and updated Project Progress Schedules shall include construction activities, milestones, and dates for events, including Schedule of Submittals.

C. The Schedule of Values shall list the installed value of component items of the Work to serve as a basis for computing values for progress payments during construction.

2.3 REQUEST FOR INFORMATION (RFI)

A. The Contractor shall submit all requirements sufficiently in advance of construction requirements to allow ample time for the Contractor and Engineer to complete their responsibilities, as specified herein, without claim and or allowance by the Contractor for delays arising from his failure in this respect.

B. Submittals shall include the CUMMING UTILITIES project name and number, and RFI number in numerical order, on the top portion, of the top page of the document(s).

2.4 SHOP DRAWINGS

A. The Contractor shall submit all requirements sufficiently in advance of construction requirements to allow ample time for the Contractor and Engineer to complete their responsibilities, as specified herein, without claim and or allowance by the Contractor for delays arising from his failure in this respect.

B. All shop drawings submitted must bear the stamp of approval of and by the Contractor as evidence that the submittal has been thoroughly reviewed and coordinated.

C. Submittals shall include the CUMMING UTILITIES project name and number, and Shop Drawing Number in numerical order, on the top portion, of the top page of the document(s).

2.5 OPERATION AND MAINTENANCE MANUALS

A. Operation and Maintenance Manuals submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers and referenced in the other parts of the manual under that specific equipment or material. Submittals that consist of various items that together constitute a manufacturer's equipment or package, or are so functionally related, must be submitted, reviewed and approved as a whole.

2.6 RECORD DRAWINGS – Refer to Section 01 78 39 "Project Record Documents"

PART 3 - EXECUTION

3.1 GENERAL

A. As applicable, submittals shall be marked in accordance to following color schemes:

1. **Manufacturer/vendor** comments shall be in '**black**' ink
2. **Contracto**r comments shall be in '**green**' ink
3. **Engineer** comments shall be in '**blue**' ink
4. **CUMMING UTILITIES** comments shall be in '**red**' ink

3.2 REVIEW PROCEDURES

A. 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. 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 specifications) or to safety precautions or programs incident thereto.

B. When the Contract Documents require a submittal by the Contractor, it shall be to the following minimum requirements:

1. Shop Drawings: Unless otherwise directed by the Engineer, six (6) copies of submitted information shall be transmitted to Engineer for review and comment. After Engineer's review and comments, Engineer shall return two (2) copies to the Contractor.

3.3 SCHEDULES

A. Preliminary Project Progress Schedule:
1. Contractor shall submit to the Engineer, a Preliminary Project Progress Schedule within ten (10) calendar days after the effective date of the Agreement.
2. The Engineer will review said Preliminary Project Progress Schedule and return reviewed copy to Contractor within fourteen (14) calendar days.
3. If required, Contractor will resubmit to Engineer, a revised Preliminary Project Progress Schedule incorporating all revisions, within ten (10) calendar days after receipt of a returned review copy.

B. Preliminary Schedule of Submittals:
1. Contractor shall submit to the Engineer, a Preliminary Schedule of Submittals within ten (10) calendar days after the effective date of the Agreement.
2. The Engineer will review said Preliminary Schedule of Submittals and return reviewed copy to Contractor, within fourteen (14) calendar days.
3. If required, Contractor will resubmit to Engineer, a revised Preliminary Schedule of Submittals incorporating all revisions, within ten (10) calendar days after receipt of a returned review copy.

C. Schedule of Values:

1. Contractor shall submit to the Owner, a Schedule of Values allocated to the

various portions of the Work, within ten (10) calendar days after the effective date of the Agreement. The value of each activity shall be a complete and total value, including all taxes, overhead, and profit. The sum of all the values of the activities shall equal the total Agreement Price. The first progress payment willnot be made until the next pay cycle following the Owner's approval of the Contractor's Schedule of Values.

2. The Owner will review said Schedule of Values and return reviewed copy to Contractor, within fourteen (14) calendar days. Upon request of the Owner, support the values with data, which will substantiate their correctness.
3. If required, Contractor will resubmit to Owner, a revised Schedule of Values incorporating all revisions, within ten (10) calendar days after receipt of a returned review copy.
4. The Schedule of Values shall be used only as a basis of the Contractor's Application for Payment.

D. Project Progress Schedule:
1. Contractor shall submit to the Engineer, an updated Project Progress Schedule within thirty (30) calendar days after the effective date of the Agreement.
2. The Engineer will review said Project Progress Schedule and return reviewed copy to Contractor within fourteen (14) calendar days.
3. If required, Contractor will resubmit to Engineer, a revised Project Progress Schedule incorporating all revisions, within ten (10) calendar days after receipt of a returned review copy.

E. Schedule of Submittals:
1. Contractor shall submit to the Engineer, an updated Schedule of Submittals within thirty (30) calendar days after the effective date of the Agreement.
2. The Engineer will review said Schedule of Submittals and return reviewed copy to Contractor, within fourteen (14) calendar days.
3. If required, Contractor will resubmit to Engineer, a revised Schedule of Submittals incorporating all revisions, within ten (10) calendar days after receipt of a returned review copy.

3.4 REQUEST FOR INFORMATION (RFI)

A. If the Contractor proposes to provide material, equipment, or method of Work which deviates from the project manual, he/she shall indicate so on the transmittal letter accompanying that specific submittal. Each RFI must be clearly marked with a numeric designation having a corresponding detailed explanation to indicate the benefit to CUMMING UTILITIES and/or the project. Submittals which do not identify deviations from the contract shall not be acceptable and shall be returned without review.

3.5 SHOP DRAWINGS

A. The Engineer shall have fourteen (14) calendar days to review and comment on a submittal after its receipt. The returned submittal shall indicate one of the following actions:

1. If the review indicates that the submittal complies with the Contract Documents,

it shall 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; no re-submittal is required.

2. If the review indicates limited corrections are required, copies shall be marked "Note Markings". The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. No re-submittal shall be required except where the submittal information shall be incorporated into the Project Operation and Maintenance Manuals, and then a corrected copy shall be incorporated.

3. If the review reveals that the submittal is insufficient and or contains incorrect data, copies shall be marked "Revise 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 with a mark of "No Exceptions Taken" or "Note Markings."

4. If the review reveals that the submittal is unacceptable it shall be marked "Rejected – See Remarks". The Contractor shall not undertake Work covered by this submittal until it has been revised, resubmitted and returned with a mark of "No Exceptions Taken" or "Note Markings."

3.6 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

A. Review of the Contractor's submittals 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 County. Also, the Contractor shall have no claim 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 "Note Markings" 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, with the exception of incorporating any Notes made by the Engineer.

3.7 COST FOR REVIEW OF SUBMITTALS

A. CUMMING UTILITIES shall pay for the review of each initial submittal and the first re-submittal required for a project. However, if the Engineer requires that shop drawings or product data be submitted for a third or more review, the Contractor shall then be responsible to pay for the Engineer's time to review the second or more re-submittal, and for each re- submittal of the same thereafter.

END OF SECTION 01 33 00

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE:

A. Permits and Responsibilities: The Contractor shall, without additional expense to the Owner, be responsible for obtaining all necessary licenses and permits, excluding those listed in Supplementary Conditions SC-6.08, and for complying with any applicable federal, state, county and municipal laws, codes, ordinances and regulations, in connection with the prosecution of the Work. The Contractor shall be responsible for coordinating and scheduling all necessary inspections required by applicable federal, state, county and municipal codes and regulations in relation to licenses and permits, including building permits issued for the project.

B. The Contractor shall take proper safety and health precautions to protect the Work, the workers, the public and the property of others.

C. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the Work.

D. The Contractor is hereby notified that a road may be under the jurisdiction of the Georgia Department of Transportation and the Forsyth County Department of Transportation, necessitating permits and notification of both entities by the Contractor.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 41 00

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 – GENERAL

1.1 DESCRIPTION:

A. Whenever reference is made to conforming to the standards of any technical society, organization, body, code or standard, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for Bids. This shall include the furnishing of materials, testing of materials, fabrication and installation practices. In those cases where the Contractor's quality standards establish more stringent quality requirements, the more stringent requirement shall prevail. Such standards are made a part hereof to the extent which is indicated or intended.

B. The inclusion of an organization under one category does not preclude that organization's standards from applying to another category.

C. In addition, all work shall comply with the applicable requirements of local codes, utilities and other authorities having jurisdiction.

D. All material and equipment, for which a UL Standard, an AGA or NSF approval or an ASME requirement is established, shall be so approved and labeled or stamped. The label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

E. The standards which apply to this Project are not necessarily restricted to those organizations which are listed in Article 1.2.

1.2 STANDARD ORGANIZATIONS:

A. Piping and Valves:
ACPA American Concrete Pipe Association
ANSI American National Standards
Institute API American Petroleum Institute
ASME American Society of Mechanical
Engineers AWWA American Water Works
Association
CISPI Cast Iron Soil Pipe Institute
DIPRA Ductile Iron Pipe Research
Association FCI Fluid Controls Institute
MSS Manufacturers Standardization
Society NCPI National Clay Pipe Institute

NSF	National Sanitation Foundation
PPI	Plastic Pipe Institute
Uni-Bell	PVC Pipe Association

B. Materials:

AASHTO	American Association of State Highway and Transportation Officials
ALS	American Lumber Standards
AMA	Acoustical Materials Association
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials

C. Painting and Surface Preparation:

NACE	National Association of Corrosion Engineers
SSPC	Society for Protective Coatings

D. Steel, Concrete, and Asphalt:

ACI	American Concrete Institute
AI	Asphalt Institute
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute
CRSI	Concrete Reinforcing Steel Institute
NRMA	National Ready-Mix Association
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute

E. Welding:

ASME	American Society of Mechanical Engineers
AWS	American Welding Society

F. Government and Technical Organizations:

AIA	American Institute of Architects
APHA	American Public Health Association
APWA	American Public Works Association
ASA	American Standards Association
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers ASQC American Society of Quality Control
ASSE	American Society of Sanitary Engineers
CFR	Code of Federal Regulations
CSI	Construction Specifications Institute
EDA	Economic Development Administration
EPA	Environmental Protection Agency
EPD	Georgia Environmental Protection Division
FCC	Federal Communications Commission
FmHA	Farmers Home Administration
FS	Federal Specifications

CUMMING UTILITIESForsyth County Department of Water and Sewer IAI International Association of Identification
ISEA Industrial Safety Equipment Association
ISO International Organization for Standardization
ITE Institute of Traffic Engineers
NBFU National Board of Fire Underwriters
(NFPA) National Fluid Power Association
NBS National Bureau of Standards
NISO National Information Standards Organization
OSHA Occupational Safety and Health Administration
SI Salt Institute
SPI The Society of the Plastics Industry, Inc.
USDC United States Department of Commerce
WEF Water Environment Federation

G. Roadways:
AREA American Railway Engineering Association
GDOT Georgia Department of Transportation
FCDOT Forsyth County Department of Transportation
SSRBC Standard Specifications for Construction of Transportation Systems, Georgia Department of Transportation

H. Plumbing:
AGA American Gas Association
NSF National Sanitation Foundation
PDI Plumbing Drainage Institute
SPC SBCC Standard Plumbing Code

1.3 SYMBOLS:

Symbols and material legends shall be as scheduled on the Drawings.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 42 19

SECTION 01 43 00
QUALITY ASSURANCE

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section covers Quality Assurance and Quality Control requirements for this contract.

B. The Contractor is responsible for controlling the quality of work, including work of its subcontractors, and suppliers and for assuring the quality specified in the Technical Specifications is achieved.

C. Refer to the General Conditions Article 6 - Contractor's Responsibilities, paragraphs 6.01, 6.02, and 6.03.

1.2 SUMMARY:

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and control services required by, including but not limited to, Engineer, Owner, or authorities having jurisdiction, are not limited by provisions of this Section.

C. Related Requirements:

1. Divisions 01 through 44 Sections for specific test and inspection requirements.

1.3 REFERENCES:

A. American Society for Testing and Materials (ASTM):

1. E329: Standard Specification for Agencies Engaged in Construction Inspection and/or Testing

1.4 DEFINITIONS:

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by a Nationally Recognized Testing Laboratory (NRTL), an (National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size,

and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.5 CONFLICTING REQUIREMENTS:

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 SUBMITTALS:

A. Shop Drawings: Provide plans, sections, dimensions, and elevations, indicating materials and size of proposed construction.

1. Indicate manufacturer and model number of individual components.

2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

C. Qualification Data: For Contractor's quality-control personnel.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.

9. Unique characteristics of each quality-control service.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN:

A. Quality Control Plan, General: Submit quality-control plan within thirty (30) days of Notice to Proceed. Submit in format acceptable to Engineer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor- elected tests and inspections.

2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."

3. Owner-performed tests and inspections indicated in the Contract Documents.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and accepted mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of accepted and rejected results. Include work Engineer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS:

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.

2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector, as applicable.
13. Recommendations on retesting and reinspection.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE:

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   d. When testing is complete, remove test specimens, assemblies; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Codes and Standards: Refer to General Conditions Article 3 - Contract Documents: Intent, Amending, Reuse, paragraph 3.02 of the General Conditions.

L. Copies of applicable referenced standards are not included in the Contract Documents. Where copies of standards are needed by the Contractor for superintendence and quality control of the work, the Contractor shall obtain a copy or copies directly from the publication source and maintain at the jobsite, available to the Contractor's personnel, subcontractors, and Engineer

M. Quality of Materials: Unless otherwise specified, all materials and equipment furnished for permanent installation in the Work shall conform to applicable standards and specifications and shall be new, unused, and free from defects and imperfections, when installed or otherwise incorporated in the Work. The Contractor shall not use material and equipment for any purpose other than that intended or specified unless the Engineer authorizes such use.

N. Where so specified, products or workmanship shall also conform to the additional performance requirements included within the Contract Documents to establish a higher or more stringent standard or quality than that required by the referenced standard.

1.10 OFFSITE INSPECTION:

A. When the specifications require inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, such services shall be performed by the Owner’s independent testing laboratory, or inspection organization acceptable to Engineer in conjunction with or by the Engineer.

B. The Contractor shall give appropriate written notice to the Engineer not less than thirty (30) days before offsite inspection services are required, and shall provide for the

producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.

1.11 MATERIALS AND EQUIPMENT:

A. The Contractor shall maintain control over procurement sources to ensure that materials and equipment conform to specified requirements in the Contract Documents.

B. The Contractor shall comply with manufacturer's printed instructions regarding all facets of materials and/or equipment movement, storage, installation, testing, startup, and operation. Should circumstances occur where the contract documents are more stringent than the manufacturer's printed instructions, the Contractor shall comply with the specifications. In cases where the manufacturer's printed instructions are more stringent than the contract documents, the Contractor shall advise the Engineer of the disparity and conform to the manufacturer's printed instructions. In either case, the Contractor is to apply the more stringent specification or recommendation, unless accepted otherwise by the Engineer.

1.12 QUALITY CONTROL:

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. The Contractor shall furnish a construction schedule and a minimum of 48 hour notice of readiness for testing and inspection of the work. The Engineer shall determine the exact time and location of field sampling and testing and may require such additional sampling and testing to determine that materials and equipment conform with data previously furnished by Contractor and with the Contract Documents.

3. The Contractor shall schedule the work to permit adequate time for testing and re-testing should test results not conform to the contract documents. Lack of testing or inspection which is attributable to insufficient notice by the Contractor or failure of the Contractor to cooperate, will be cause for rejection of the work.

4. The Contractor shall deliver materials in sufficient quantities to the Owner's testing agency as may be required. Laboratory testing shall be performed within a reasonable time, consistent with the specified standards.

5. The Contractor shall furnish material samples and cooperate in the field sampling and testing activities, interrupting the work when necessary. The Contractor shall furnish personnel, facilities and access to assist in the sampling and testing activities.

6. Costs for retesting and reinspection construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

3. Comply with manufacturers' instructions, including each step in sequence.

4. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

5. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

6. Perform Work by persons qualified to produce required and specified quality.

7. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

8. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

9. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

10. Notify testing agencies at least twenty-four (24) hours in advance of time when Work that requires testing or inspecting will be performed.

11. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

12. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

13. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Tolerances:

1. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

2. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

3. Adjust products to appropriate dimensions; position before securing products in place.

D. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections.

E. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

F. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that replaced Work that failed to comply with the Contract Documents.

G. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

H. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as

requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

I. Coordination: Coordinate sequence of activities to accommodate required quality- assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

J. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.13 SPECIAL TESTS AND INSPECTIONS:

A. Special Tests and Inspections: Owner will engage a qualified agency to conduct special tests and inspections required, as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality- control service to Engineer with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspection corrected work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

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

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION:

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

3.3 QUALITY CONTROL:

A. Quality control is the responsibility of the Contractor, and the Contractor shall maintain control over construction and installation processes to assure compliance with specified requirements.

B. Certifications for personnel, procedures, and equipment associated with special processes (e.g., welding, cable splicing, surveying) shall be maintained by the Contractor, available for inspection by the Engineer. Copies shall be made available to the Engineer upon request.

C. Means and methods of construction and installation processes are the responsibility of the Contractor, and at no time is it the intent of the Engineer to supersede or void that responsibility.

3.4 TEST AND INSPECTION LOG:

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

3.5 REPAIR AND PROTECTION:

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 29 Cutting and Patching.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 43 00

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.01 SCOPE:

A. This Section includes testing which the Owner may require, beyond that testing required of the manufacturer, to determine if materials provided for the Project meet the requirements of these Specifications.

B. This work also includes all testing required by the Owner to verify work performed by the Contractor is in accordance with the requirements of these Specifications, i.e., concrete strength, slump testing, soil compaction, etc.

C. This work does not include materials testing required in various sections of these Specifications to be performed by the manufacturer.

D. The testing laboratory or laboratories will be selected by the Owner. The testing laboratory or laboratories will work for the Owner.

1.02 PAYMENT FOR TESTING SERVICES:

A. Testing services provided by the Owner will be paid by the Owner through CUMMING UTILITIES annual material testing contract. Testing services provided by the Contractor will be from the County's approved list but paid by the Contractor.

B. The cost of material testing described in various sections of these Specifications or as required in referenced standards to be provided by a material manufacturer, shall be included in the price bid for that item and shall not be paid for by the Owner.

C. The cost of retesting any item that fails to meet the requirements of these Specifications shall be paid for by the Contractor. Retesting shall be performed by the testing laboratory working for the Owner.

1.03 LABORATORY DUTIES:

A. Cooperate with the Owner, Engineer and Contractor.

B. Provide qualified personnel promptly on notice.

C. Perform specified inspections, sampling and testing of materials.

1. Comply with specified standards, ASTM, other recognized authorities, and as specified.

2. Ascertain compliance with requirements of the Contract Documents.

B. Promptly notify the Engineer and Contractor of irregularity or deficiency of work which are observed during performance of services.

C. Promptly submit three (3) copies of report of inspections and tests in addition to those additional copies required by the Contractor; one (1) copy to the Owner, one (1) copy to the Engineer, and one (1) copy to the Contractor, with the following information included:
1. Date issued
2. Project title and number
3. Testing laboratory name and address
4. Name and signature of inspector
5. Date of inspection or sampling
6. Record of temperature and weather
7. Date of test
8. Identification of product and Specification section
9. Location of Project
10. Type of inspection or test
11. Results of test
12. Observations regarding compliance with the Contract Documents

D. Perform additional services as required.

E. The laboratory is not authorized to release, revoke, alter or enlarge on requirements of the Contract Documents, or approve or accept any portion of the Work.

1.4 CONTRACTOR RESPONSIBILITIES:

A. Cooperate with laboratory personnel; provide access to Work and/or manufacturer's requirements.

B. Provide to the laboratory, representative samples, in required quantities, of materials to be tested.

C. Furnish copies of mill test reports.

D. Furnish required labor and facilities to:

1. Provide access to Work to be tested;
2. Obtain and handle samples at the site;
3. Facilitate inspections and tests;

4. Provide a clear, level and unobstructed location for placement of concrete curingbox(es) adjacent to the work area as agreed upon with the testing laboratory and the Engineer. Provide power and lighting at the curing box location.

E. 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” x 12” cylinders. Use of field constructed curing boxes will not be acceptable.

F. Notify the laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.

G. 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.

H. Copies of all correspondence between the Contractor and testing agencies shall be provided to the Engineer.

1.5 QUALITY ASSURANCE:

A. Testing shall be in accordance with all pertinent codes and regulations and with procedures and requirements of the American Society for Testing and Materials (ASTM).

1.6 PRODUCT HANDLING:

A. Promptly process and distribute all required copies of test reports and related instructions to ensure all necessary retesting or replacement of materials with the least possible delay in the progress of the Work.

1.7 FURNISHING MATERIALS:

A. The Contractor shall be responsible for furnishing all materials necessary for testing.

1.8 CODE COMPLIANCE TESTING:

A. 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.

1.09 CONTRACTOR'S CONVENIENCE TESTING:

A. Inspection or testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

1.10 SCHEDULES FOR TESTING:

A. Establishing Schedule

1. The Contractor shall, by advance discussion with the testing laboratory selected by the Owner, determine the time required for the laboratory to perform its tests and to issue each of its findings, and make all arrangements for the testing laboratory to be on site to provide the required testing.

2. Provide all required time within the construction schedule.

B. When changes of construction schedule are necessary during construction, coordinate all such changes of schedule with the testing laboratory as required.

C. When the testing laboratory is ready to test according to the determined schedule but is prevented from testing or taking specimens due to incompleteness of the Work, all extra costs for testing attributable to the delay will be back-charged to the Contractor and shall not be borne by the Owner.

1.11 TAKING SPECIMENS:

A. Unless otherwise provided in the Contract Documents, all specimens and samples for tests will be taken by the testing laboratory or the Engineer.

1.12 TRANSPORTING SAMPLES:

A. The Contractor shall be responsible for transporting all samples, except those taken by testing laboratory personnel, to the testing laboratory.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 45 29

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 SCOPE:

A. Temporary facilities required for this work include, but are not necessarily limited to:

1. Temporary utilities such as water and electricity.
2. First aid facilities.
3. Sanitary facilities.
4. Potable water.
5. Temporary enclosures and construction facilities.

1.02 GENERAL:

A. First aid facilities, sanitary facilities and potable water shall be available on the Project site on the first day that any activities are conducted on site. The other facilities shall be provided as the schedule of the Project warrants.

B. Maintenance: Use all means necessary to maintain temporary facilities in proper and safe condition throughout progress of the Work. In the event of loss or damage, immediately make all repairs and replacements necessary, at no additional cost to the Owner.

C. Removal: Remove all such temporary facilities and controls as rapidly as progress of the Work will permit.

1.03 TEMPORARY UTILITIES:

A. General

1. Provide and pay all costs for all utilities required for the performance of the Work.
2. Pay all costs for temporary utilities until Project completion.
3. Costs for temporary utilities shall include all utilities necessary for the performance of testing as required by the Contract Documents.

B. Temporary Water: Provide all necessary temporary piping, and upon completion of the Work, remove all such temporary piping.

C. Temporary Electricity:

1. Provide all necessary wiring for the Contractor's use.
2. Furnish, locate and install area distribution boxes such that the individual trades

may use, their own construction type extension cords to obtain adequate power, and artificial lighting at all points where required for safety.

3. Provide all temporary electrical services, wire, generators, etc. required for performance of the Work inclusive of maintaining existing facilities in service during required service shutdowns.
4. Pay all fuel bills for temporary power required for the performance of the Work where required during shutdowns, bypass pumping etc.

D. Lighting: Provide temporary lighting to meet all applicable safety requirements to allow application or installation of materials and equipment, and observation or inspection of the Work.

E. Water:
1. Provide temporary facilities and piping required to bring water to point of use and remove when no longer needed. Install an acceptable metering device for measuring water used.

2. Provide a means to prevent water used for construction and testing from flowing back into source pipeline. Device(s) shall be as approved by Owner for backflow prevention.

1.4 FIRST AID FACILITIES:

A. The Contractor shall provide a suitable first aid station, equipped with all facilities and medical supplies necessary to administer emergency first aid treatment. The Contractor shall have standing arrangements for the removal and hospital treatment of any injured person. All first aid facilities and emergency ambulance service shall be made available by the Contractor to the Owner and the Engineer's personnel.

1.5 SANITARY FACILITIES:

A. Prior to starting the Work, the Contractor shall furnish, for use of Contractor's personnel on the job, subcontractors, and all other on-site personnel, all necessary toilet facilities which shall be secluded from public observation, as much as practical. These facilities shall be chemical toilets. All facilities shall be kept in a clean and sanitary condition and shall comply with the requirements and regulations of the area in which the Work is performed. Adequacy of these facilities will be subject to the Engineer's review and maintenance of same must be satisfactory to the Engineer at all times.

B. Use of Owner’s existing sanitary facilities by construction personnel will not be allowed.

1.6 POTABLE WATER:

A. The Contractor shall be responsible for furnishing a supply of potable drinking water for employees, subcontractors, inspectors, engineers and the Owner who are associated with the Work.

1.7 ENCLOSURES AND CONSTRUCTION FACILITIES:

A. Furnish, install and maintain for the duration of construction, all required scaffolds, tarpaulins, canopies, steps, bridges, platforms and other temporary construction necessary for proper completion of the Work in compliance with all pertinent safety and other regulations.

1.8 PARKING FACILITIES:

A. Parking facilities for the Contractor's and Contractor's subcontractors' personnel shall be the Contractor's responsibility.

PART 2 – PRODUCT (NOT USED)

PART 3 – EXECUTION

3.1 PROTECTION OF WORK AND PROPERTY:

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
3. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal and/or relocation of existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor’s operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and

such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection thereof have been made by Contractor.

8. Utility Interruptions:

   a. Notify property owners and utility owner offices that may be affected by construction operation at least two (2) days in advance.

   b. Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.

9. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.

10. Maintain original site drainage wherever possible.

B. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on the Drawings to remain undisturbed.

   a. Where practical, tunnel beneath trees when on or near line of trench.

   b. Employ hand excavation as necessary to prevent tree injury.

   c. Do not stockpile materials or permit traffic within drip lines of trees.

   d. Provide and maintain temporary barricades around trees.

   e. Water vegetation as necessary to maintain health.

   f. Cover temporarily exposed roots with wet burlap and keep burlap moist until soil is replaced around roots.

   g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.

   h. Dispose of removed trees in a legal manner off the site.

2. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.

3. Replace each plant that dies as a result of construction activities.

C. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

D. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

3.02 TEMPORARY CONTROLS:

A. Air Pollution Control:

1. Minimize air pollution from construction operations.

2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to site.

3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.

2. Noise Control Ordinance: F County Code of Ordinances, Section 42 - 46 through 42 - 48.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.

2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.

3. Comply with procedures outlined in U.S. Environmental Protection Agency manuals entitled, "Guidelines for Erosion and Sedimentation Control Planning" and "Implementation, Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity," and "Erosion and Sediment Control-Surface Mining in Eastern United States."

4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and lawful disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control:

1. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

2. Install erosion and sediment controls as shown on the Drawings, in accordance with applicable local, state, and federal regulations, and as directed by the Engineer.

3.03 STORAGE YARDS AND BUILDINGS:

A. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

B. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.

2. Arrange or partition to provide security of contents and ready access for inspection and inventory.

3. Store combustible materials (paints, solvents, fuels, etc.) in a well-ventilated and remote building meeting safety standards.

3.4 PARKING AREAS:

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on the Project.

END OF SECTION 01 50 00

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE:

A. These general product stipulations apply to all equipment and piping. They supplement the detailed product Specifications, but in case of conflict, the detailed product Specifications shall govern.

1.2 COORDINATION:

A. The Contractor shall assume full responsibility for the coordination of the installation of all equipment, materials and products furnished under these Contract Documents. The Contractor shall be completely responsible for verification that all structures, piping and equipment components furnished by the Contractor and/or subcontractors and suppliers are compatible. The Contractor shall place in service, each pipeline system and shall make all necessary alterations. All such alterations shall be made at the Contractor's expense.

1.3 ADAPTATION AND LOCATION OF EQUIPMENT:

A. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the Owner. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.

B. The Contractor shall install the work in such manner that the equipment, piping, vents, conduit, panels, ductwork and appurtenances be as neatly installed with adequate space for maintenance and passage of personnel.

1.4 PATENT ROYALTIES:

A. All royalties and fees for patents covering materials, articles, apparatus, devices or equipment shall be included in prices bid by the Contractor.

1.5 WARRANTY:

A. The Contractor shall warrant all work against faulty or inadequate installation, improper assembly or erection, defective materials, breakage or other failure. The warranty period shall be defined in Section 01 78 36 of these Specifications.

1.6 WORKMANSHIP AND MATERIALS:

A. All products shall be designed, fabricated and assembled in accordance with the most modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Products shall be new and shall not have been in service at any time prior to delivery, except as required by tests.

B. Materials shall be suitable for service conditions. Iron castings shall be tough, close grained, gray iron free from blowholes, flaws or excessive shrinkage and shall conform to ASTM A48, Class 30 minimum. Plugging of defective castings shall not be permitted. Castings shall be annealed to remove internal stresses prior to machining and shall have the mark number and heat number cast on them.

C. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads.

F. All products delivered to the Project site shall include detailed installation instructions and a parts list.

1.7 EQUIPMENT SPECIFICATIONS:

A. The use of singular or plural terminology in the Specifications is not intended to define the number of units required to fulfill Contract requirements. Bidders must consult the Drawings and Specifications to determine how many units of a particular product are required. This does not relieve the Contractor of the responsibility to provide all equipment specified when multiple units are specifically required in the Specifications.

1.8 GROUTING:

A. A special epoxy, non-shrink, or sand-cement grout shall be used in grouting applications as shown on the Drawings.

1.9 WELDING AND BRAZING:

A. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous, and where exposed to view, shall be ground smooth. All continuous welds shall be gas and liquid-tight. Welds in piping shall have full penetration and shall be smooth on the inside of the pipe. Intermittent welds shall have an effective length of at least two (2) inches and shall be spaced not more than six (6) inches apart.

B. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds, and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Welding Code shall also apply to welded aluminum structures. The welding process and welding operators

shall meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding, and Section 328, Brazing and Soldering. All welding qualification tests shall be witnessed by the Engineer, except as provided herein. All costs associated with the qualification or testing of welders and welding operators shall be borne by the Contractor.

C. Reports certifying that the welding procedures, welders and welding operators that the Contractor intends to use meet the requirements specified above. These reports shall be submitted to the Engineer prior to beginning the Work. In the case of welder qualifications for shop welding and for carbon steel field welding, welders presenting certified qualification papers validated within the preceding six (6) month period will not be required to take the qualification tests. In the case of field welding of stainless steel or aluminum, all welders shall be required to take the qualification tests regardless of past experience or availability of certified qualification papers.

D. Field welding practices shall conform to OSHA construction standards, Part 1926, Subpart J, Welding and Cutting. Shop welding practices shall conform to OSHA General Industry Standards, Part 1910, Subpart Q, Welding, Cutting, and Brazing.

E. Welding electrodes for structural steel shall conform to the standard recommendations of the AISC. Welding electrodes for stainless steel shall conform to applicable AWS Specifications and shall be as recommended by “Welded Austenitic Chromium-Nickel Stainless Steels, Techniques and Properties”, published by the International Nickel Company, New York, New York. Welding electrodes for aluminum shall conform to applicable AWS Specifications.

F. Each welder and welding operator must identify all welds with welder's assigned symbol.

G. Welders performing unsatisfactory work shall be removed from the welding process.

H. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor's expense. Excessive porosity, nonmetallic inclusions, lack of fusion, incomplete penetration and cracking shall constitute grounds for rejection of welds.

1.10 SHOP PRIMING AND PAINTING:

A. All factory and shop priming and painting, including surface preparation, workmanship and materials, shall be as specified by manufacturer.

1.11 FIELD PRIMING:

A. All iron and carbon steel surfaces not specified to be galvanized or shop primed and all ferrous or nonferrous surfaces specified to be field primed and painted shall be coated in the field with one or more coats of primer in accordance with the manufacturer's specifications.

1.12 FIELD PAINTING:

A. Except for interior surfaces of vessels and enclosed equipment not specified to be field painted, all ferrous and nonferrous surfaces of equipment which have received one or more coats of shop or field applied primer shall be field painted after installation in accordance with the manufacturer's specifications.

1.13 GALVANIZING:

A. All galvanizing shall be done by the hot-dip process after fabrication in conformity with requirements of ASTM A 123, Grade 100; ASTM A 153, ASTM A 384 and ASTM A 385. Articles to be galvanized shall be pickled before galvanizing. Articles to be painted shall not be quenched.

B. Where galvanized bolts are specified or required by the Drawings, zinc plated bolts will be acceptable provided zinc plating conforms to ASTM B 633, Type II.

C. Areas of galvanizing damaged at the factory by welding or burning or otherwise damaged shall be thoroughly stripped and cleaned and recoated with zinc to the required thickness by the hot dip process. Areas of galvanizing damaged in the field during transportation, handling or installation shall be stripped, cleaned, and recoated with zinc to the required thickness in accordance with ASTM A 780, Annex A3.

D. Galvanized articles shall be free from uncoated spots, blisters, flux, black spots, dross, projections and other defects not consistent with acceptable galvanizing practice.

E. Zinc and cadmium plating shall be subject to visual examination to determine uniformity of coating. The Engineer may require that the coating uniformity be tested in accordance with ASTM A 239 or ASTM E 376.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 60 00

SECTION 01 65 00
PRODUCT DELIVERY REQUIREMENTS

PART 1 – GENERAL

1.1 SCOPE:

A. The Contractor shall provide transportation of all equipment, materials and products furnished under these Contract Documents to the Work site. In addition, the Contractor shall provide preparation for shipment, loading, unloading, handling and preparation for installation and all other work and incidental items necessary or convenient to the Contractor for the satisfactory prosecution and completion of the Work.

B. All equipment, materials and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the Work.

1.2 PREPARATION FOR SHIPMENT:

A. When practical, factory-assemble products. Match mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with a strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project, and Contractor, product number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

C. Deliver materials to project site and place at a location determined by Contractor.

D. Notify Engineer and Owner’s Inspector upon arrival.

E. Protect equipment from exposure to the elements and keep dry and dust-free as far as practical. Protect painted surfaces against impact, abrasion, discoloration, or other damage.

F. For major items, request a minimum seven (7) day advance notice of shipment from manufacturers. Upon receipt of manufacturer’s advance notice of shipment, promptly notify Engineer of anticipated date of equipment arrival.

G. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.3 TRANSPORTATION:

A. All products shall be suitably boxed, crated or otherwise protected during transportation.

B. Where products will be unloaded using cranes, forklifts, or other hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the hoisting equipment.

C. Small items and appurtenances such as gauges and valves, which could be damaged during shipment shall be removed from the equipment prior to shipment, packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.

1.4 HANDLING:

A. Handle products in accordance with the manufacturer's written instructions, and in a manner to prevent damage. Store products, upon delivery, in accordance with manufacturer's instructions, with labels intact and legible, in approved storage yards or sheds. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice.

C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.

D. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.

1.5 OWNER FURNISHED EQUIPMENT:

A. Owner furnished equipment shall mean any Owner purchased equipment and such being required by these Specifications to be installed by the Contractor.

B. The Contractor shall off load and store all Owner furnished equipment per this Section of these Specifications.

PART 2 – PRODUCTS (NOT USED) PART 3 –

EXECUTION (NOT USED)

END OF SECTION 01 65 00

SECTION 01 66 00
PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 – GENERAL

1.01 SCOPE:

A. The work under this Section includes, but not 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.

1.02 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.

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 clean and dry, as far as practical. All products 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. 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.

G. Parts and equipment not requiring periodic inspection or maintenance shall be stored unopened in their original packaging until used.

H. 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.

I. 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.

J. 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 placing in service by the Contractor at Contractor's own expense.

K. Unless otherwise permitted in writing by the Engineer, building products and materials such as cement, grout, plaster, particleboard, finish lumber, 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.

L. 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 OWNER FURNISHED EQUIPMENT:

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

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 66 00

SECTION 01 71 23.16
CONSTRUCTION SURVEYING

PART 1 – GENERAL

1.1 SCOPE:

A. Construction surveying shall include all of the surveying work required to layout the Work and control the location of the finished Project. The Contractor shall have the full responsibility for constructing the Project to the correct horizontal and vertical alignment, as shown on the Drawings, as specified, or as directed by the Engineer. The Contractor shall assume all costs associated with rectifying work constructed in the wrong location.

B. From the information shown on the Drawings and the information to be provided as indicated under Project Conditions below, the Contractor shall:

1. Be responsible for setting reference points and/or offsets, establishment of baselines, and all other layout, staking, and all other surveying required for the construction of the Project.
2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
3. Stake out the permanent and temporary easements or the limits of construction to ensure that the Work is not deviating from the indicated limits.
4. Be responsible for all damage done to reference points, baselines, center lines and temporary benchmarks, and shall be responsible for the cost of re-establishment of reference points, baselines, center lines and temporary benchmarks as a result of the operations.

C. Baselines shall be defined as the line to which the location of the Work is referenced, i.e., edge of pavement, road centerline, property line, right-of-way or survey line.

D. Record Drawing surveys shall be performed in accordance with Section 01 78 39.

1.2 PROJECT CONDITIONS:

A. The Drawings provide the location and/or coordinates of principal components of the Project. The alignment of some components of the Project may be indicated in the Specifications. The Engineer may order changes to the location of some of the components of the Project or provide clarification to questions regarding the correct alignment.

B. The location and elevation of benchmarks are shown on Drawings.

C. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.

1.3 QUALITY ASSURANCE:

A. The Contractor shall furnish documentation, prepared by a surveyor currently registered in the State of Georgia, confirming that staking is being done to the horizontal and vertical alignment shown in the Contract Documents. This requires that the Contractor hire, at the Contractor's own expense, a currently registered surveyor, acceptable to the Owner, to provide ongoing construction staking or confirmation of such.

B. Any deviations from the Drawings shall be confirmed by the Engineer prior to construction of that portion of the Project.

C. Construction Verification Surveying

1. The Engineer may verify the Contractor’s reference points, centerlines and work performed. This verification activity in no way relieves the Contractor of the responsibility of installing reference points, centerlines, temporary benchmarks, verifying that the work has been performed accurately, and all other work covered by this Section.

1.4 SITE WORK:

A. Staking Precision: The precision of construction staking shall match the precision of a component’s location indicated on the Drawings. Staking of utilities shall be done in accordance with generally accepted practice for the type of utility.

B. Written certification, by a licensed surveyor, that structure base grade and structure locations match the locations shown on the Drawings is required prior to beginning construction of the structure.

C. Paved Surfaces: The Contractor shall establish a reference point for establishing and verifying the paving subgrade and finished grade elevations. Any variance with plan grades shall be identified by the Contractor and confirmed by the Engineer prior to constructing the road base.

PART 2 – PRODUCTS (NOT USED) PART 3 –

EXECUTION (NOT USED)

END OF SECTION 01 71 23.16

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 – GENERAL

1.1 SCOPE:

A. The work under this Section includes, but is not necessarily limited to, cutting and patching work as indicated on the Drawings, herein specified and as necessary for proper and complete performance of the Work.

B. Requirements for cutting and patching may be described in various sections of these Specifications.

C. Execute cutting, including excavating and filling, or patching of work required to:

1. Make several parts fit properly.
2. Uncover work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of the Contract Documents.
5. Remove samples of the installed work as specified for testing.
6. Install specified work in existing construction.

B. In addition, upon written instruction of the Engineer:

1. Uncover work to provide for the Engineer's observation of covered work.
2. Remove samples of the installed materials for testing.
3. Remove work to provide for alteration of existing work.

C. Protection of Work:

1. Do not endanger any work by cutting or altering the Work or any part of it.
2. Do not cut or alter the work of another contractor without written consent of the Engineer.

1.2 SUBMITTALS:

A. Prior to cutting which affects the structural safety of the Project or the work of another contractor, submit a written notice to the Engineer requesting consent to proceed with cutting. The notice shall include:

1. Identification of Project.
2. Description of defective Work.
3. Necessity for cutting.
4. Effect on other work or on the structural integrity of the Project.

5. Description of the proposed work including:

    a. Scope of cutting and patching
    b. Subcontractor and trades to execute work
    c. Products proposed to be used
    d. Extent of refinishing

6. Alternatives to cutting and patching.
7. Designation of party responsible for the cost of cutting and patching.

B. Cost Estimate: Prior to cutting and patching performed on instruction of the Engineer, submit a cost estimate.

C. Should conditions of the Work or the schedule necessitate alternative materials or methods, submit a written recommendation to the Engineer that includes:

1. Compelling conditions for alternative materials or methods.
2. Recommended alternative materials or methods.
3. Submittals as required for substitutions.

D. Uncovered Work: Submit written notice to the Engineer designating the time the work will be uncovered for the Engineer's observation.

1.3 PAYMENT FOR COST:

A. Contractor's Costs: Costs caused by ill-timed or defective work or work not conforming to the Contract Documents, including costs for additional services of the Engineer, shall be paid by the Contractor.

B. Owner's Costs: Cost of work done as the result of the Engineer’s/Owner’s instructions, which is not shown on the Drawings or specified, other than defective or non- conforming work, will be paid for by the Owner.

PART 2 – PRODUCTS

2.1 MATERIALS:

A. All products and materials shall conform to the requirements of the Specifications for the type of work being performed, except where no products are specified in these Specifications for the item being replaced; then the products and materials shall be of an equivalent type, quality, thickness and width of the item removed.

PART 3 – EXECUTION

3.1 INSPECTION:

A. Inspect existing conditions of the Work including elements subject to movement or damage during cutting and patching or excavating and backfilling.

B. After uncovering work, inspect conditions affecting the installation of new products.

3.2 PREPARATION:

A. Provide shoring, bracing and support as required to maintain structural integrity of the Project.

B. Provide protection for other portions of the Project and provide protection from the elements.

3.3 PERFORMANCE:

A. Execute fitting and adjustments of products to provide finished installation that complies with specified tolerances and finishes.

B. Execute cutting and demolition by means that will prevent damage to other work and will provide proper surfaces to receive installation of repairs and new work.

C. Execute excavating and backfilling as specified in Section 31 23 00 Excavation and Fill.

D. Restore work which has been cut or removed and install new products to provide completed work in accordance with the requirements of the Contract Documents.

E. Refinish entire surfaces as necessary to provide an even finish. Continuous surfaces shall be refinished to the nearest intersection and assemblies shall be entirely refinished.

END OF SECTION 01 73 29

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes administrative and procedural requirements for:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 01 50 00 Temporary Facilities and Controls for environmental-protection measures during construction, and location of waste containers at Project site.
2. Section 31 11 00 Clearing and Grubbing for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS:

A. Construction Waste: Structure and site improvement materials and other solid waste resulting from construction, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Structure and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycle, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS:

A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Structural and miscellaneous steel.
g. Piping.
h. Supports and hangers.
i. Valves.
j. Sprinklers.

2. Construction Waste:

a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Piping.
g. Electrical conduit.
h. Packaging: Salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.4 INFORMATIONAL SUBMITTALS:

A. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan.
2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.

1.6 WASTE MANAGEMENT PLAN:

A. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and construction waste generated by the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION:

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 01 50 00 Temporary Facilities and Controls.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three (3) days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 Temporary Facilities and Controls for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE:

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL:

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Receivers and Processors: List below is provided for information only; available recycling receivers and processors include, but are not limited to, the

following:

1. Blaze Recycling.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE:

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch (38-mm) size.

1. Crush asphaltic concrete paving.
2. Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch (38-mm) size.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch (38-mm) size.

2. Clean and stack undamaged, whole masonry units on wood pallets.

3.5 RECYCLING CONSTRUCTION WASTE:

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
   a. Comply with requirements in Section 32 92 00 Turf and Grasses for use of clean sawdust as organic mulch.

3.6 DISPOSAL OF WASTE:

A. General: 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.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from site and legally dispose of them.

END OF SECTION 01 74 19

SECTION 01 74 23

FINAL CLEANING

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 in accordance with Georgia Environmental Protection Division rules.

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 methods and equipment which are compatible with the type of waste being removed, 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.

3.2 FINAL CLEANING:

A. Definitions: Unless otherwise specifically specified, “clean” for the purpose of this Article shall be interpreted as removal of all tools, equipment, surplus materials, scrap, debris, trash, or other waste materials from the site; restoring the site to its pre-construction condition.

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 3.1 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.

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.

END OF SECTION 01 74 23

SECTION 01 78 36
WARRANTIES

PART 1 – GENERAL

1.1 PROJECT MAINTENANCE AND WARRANTY:

A. Maintain and keep in good repair the Work covered by these Drawings and Specifications until acceptance by the Owner.

B. Warranty Period: The Contractor shall warrant for a period of one (1) year from the date of 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, and the Contractor shall 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.

C. The Contractor shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another Contractor or the Owner, or to perform any work which is normally performed by a maintenance crew during operation.

D. In the event of multiple failures of major consequences prior to the expiration of the one (1) year warranty described above, the affected work shall be disassembled, inspected and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the failure shall be replaced. A new warranty period equal to the original warranty period shall be provided against defective or deficient design, workmanship, and materials and shall commence on the day that the item is reassembled and placed back into operation. As used herein, multiple failure shall be interpreted to mean two (2) or more successive failures of the same kind in the same item or failures of the same kind in two or more items. Major failures may include, but are not limited to, cracked or broken piping, or vessels, excessive deflections, excessive wear or excessive leakage around seals. Failures which are directly and clearly traceable to operator abuse, such as operations in conflict with published operating procedures or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over-or under-lubrication and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one (1) year warranty. Should multiple failures occur in a given item, all products of the same size and type shall be inspected, modified or replaced as necessary and rewarranted for the original full Warranty Period.

E. The Contractor shall, at Contractor's own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals and shall perform such

work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by the Contractor. Such repair shall also include refilling of trenches, excavations or embankments which show settlement or erosion after backfilling or placement.

F. Except as noted on the Drawings or as specified, all structures such as embankments and fences shall be returned to their original condition prior to the completion of the Contract. Any and all damage to any facility not designated for removal, resulting from the Contractor's operations, shall be promptly repaired by the Contractor at no cost to the Owner.

G. The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of one (1) year from the date of final acceptance. In the event the repairs and maintenance are not made immediately, and it becomes necessary for the owner of the road to make such repairs, the Contractor shall reimburse the owner of the road for the cost of such repairs.

H. In the event the Contractor fails to proceed to remedy the defects upon notification within ten (10) days of the date of such notice, the Owner reserves the right to cause the required materials to be procured and the work to be done, as described in the Drawings and Specifications, and to hold the Contractor and the sureties on Contractor's bond liable for the cost and expense thereof.

I. Notice to Contractor for repairs and reconstruction will be made in the form of a registered letter addressed to the Contractor at Contractor's home office.

J. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of the Contractor's liability within the law of the place of construction.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION 01 78 36

SECTION 01 78 39
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION

INCLUDES: Section

Title	
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Qualified Personnel
3.1	Maintenance of Documents and Samples
3.2	Record Drawings
3.3	GPS Coordinates for Water Projects
3.4	GPS Coordinates for Sanitary Sewer Projects
3.5	GPS Coordinates for Stormwater Projects

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.

1.3 WORK INCLUDED

A. The Contractor shall, under this item, furnish all material, tools, labor, and equipment necessary to properly compile, prepare, maintain, record, and submit Project Record Documents as specified herein.

B. Project Record Documents to be prepared and submitted by the Contractor include, but are not limited to Record Drawings, Specifications, Change Orders and other modifications to the Contract, Engineer field orders or written instructions, Requests for Information (RFI) and Clarification Memorandums, reviewed shop drawings, product data and samples, and test records. Final payment will not be made until all Project Record Documents are submitted and approved by the Engineer and CUMMING UTILITIES.

C. The Contractor shall maintain on the project site an updated set of Record Drawings. These Drawings must be the latest revision, and match those of CUMMING UTILITIES.

1.4 SUBMITTALS

A. Submit for approval in accordance with Section 01 33 00 SUBMITTAL PROCEDURES, the following items:
   1. Record Drawings.
   2. Specifications.

3. Change Orders and other Contract modifications.
4. Engineer/Owner Field Orders.
5. Requests for Information (RFI) and Clarification Memorandums.
6. Approved shop drawings, product data, and samples.
7. Test records.
8. Valve cards providing a 3 point measurement on each valve to a fixed permanent reference point.
9. GPS Coordinates for all fire hydrants, valves, manholes, and other structures and appurtenances installed.

B. Contractor shall accompany each submittal with transmittal letter containing date, project title and number, Contractor's name and address, title and number of each record document, and signature of Contractor's authorized representative.

PART 2 – PRODUCTS

2.1 QUALIFIED PERSONNEL

A. Contractor shall furnish qualified and experienced person, whose duty and responsibility shall be to maintain Project Record Documents.

PART 3 - EXECUTION

3.1 MAINTENANCE OF DOCUMENTS AND SAMPLES

A. Maintain secure storage for documents and product samples in the Contractor's field office, or an agreed upon location when field offices are not used, apart from documents used for construction. Example acceptable locations may include lockable tool trailer at the lay down area or superintendent's work vehicle. In any case documents shall be kept neat and secure.

B. File documents and samples in accordance with format of these specifications.

C. Maintain documents in a neat, clean, dry, legible condition and in good order. Do not use record documents for construction purposes. Maintain at an agreed upon site for CUMMING UTILITIES, one (1) copy of all Project Record Documents.

D. Make documents and samples available at all times for inspection by the Engineer, or CUMMING UTILITIES.

E. Failure to maintain up-to-date P r o j e c t Record Documents, in a satisfactory manner, may be cause for withholding of a certificate for payment.

F. 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.

3.2 RECORD DRAWINGS

A. The Contractor must maintain an up-to-date Field Record set of drawings by marking changes and other information directly on a clean set of full-size Contract Drawings. The Contractor shall submit for Engineer and CUMMING UTILITIES approval, up- to-date Record Drawings with monthly pay applications.

Approval of monthly pay applications will not occur until the updated record drawings are approved.
The Engineer and CUMMING UTILITIES will review the record drawings to confirm that the recorded information is current.

B. Record information concurrently with construction progress. Do not conceal any Work until required information is recorded. Make entries within twenty-four (24) hours after receipt of information that a change in Work has occurred.

C. Unless otherwise noted, Record Drawings shall provide dimensions, distances, and coordinates to the nearest one tenth foot (0.1').

D. Unless otherwise noted, Record Drawings shall provide elevations to the nearest one- hundredth foot (0.01') for all pertinent items constructed by the Contractor.

E. 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.

F. Record Drawings shall include details not on original Drawings to accurately depict actual constructed items.

G. Legibly mark drawings using erasable colored pencils to record actual construction, including:
1. Color Coding: RED – When showing information added to drawings
GREEN – When showing information deleted from drawings
BLUE – When showing information notes on drawings
2. Date all entries.
3. Call attention to each entry by drawing a "cloud" around area(s) affected.
4. For water mains, legibly mark to record actual changes made during construction, including but not limited to:
    a. Depth of valve or meter vaults in relation to finished grade data if not shown, or where depth differs from that indicated on the Drawings. Provide the elevation of piping through the vaults.
    b. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference at least two measurements to permanent surface improvements.
    c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
    d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.

e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

4. For Sewer, legibly mark to record actual changes made during construction, including but not limited to:
   a. Invert elevations of all pipes entering manholes, junction boxes, etc.
   b. Top elevations (ring and cover) of all manholes, vaults, etc.
   c. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference at least two measurements to permanent surface improvements.
   d. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   e. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   f. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

5. For Stormwater mains, legibly mark to record actual changes made during construction, including but not limited to:
   a. Invert elevations of all pipes entering stormwater structures (Catch Basins, Yard Inlets, Junction Boxes, Headwalls, etc.).
   b. Top elevations (ring and cover, grate, throat, etc.) of all stormwater structures.
   c. Locate existing facilities, piping, equipment, and items critical to the construction.
   d. Changes made by Addenda, Field Orders, Work Change Directive, Change Order, Written Amendment, and Engineer's written interpretation and clarification, using consistent symbols for each and showing appropriate document tracking number.

3.3 GPS COORDINATES FOR WATER 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.

3.4 GPS COORDINATES FOR SANITARY SEWER PROJECTS

A. At the completion of construction, the Contractor shall provide GPS coordinates for all newly installed and relocated manholes, valves, and valve vaults. 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.

3.5 GPS COORDINATES FOR STORMWATER PROJECTS

A. At the completion of construction, the Contractor shall provide GPS coordinates for all newly installed and relocated Stormwater structures, (Catch Basins, Yard Inlets, Junction Boxes, etc.). 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. For force mains, as installation of the 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 the staked offsets.

END OF SECTION 01 78 39

SECTION 02 32 19
EXPLORATORY EXCAVATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION

INCLUDES: Section

Title	
1.2	References
1.3	Work Included
1.4	Submittals
3.1	Exploratory Excavation

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Excavation and Fill (31 23 00).
2. Erosion and Sedimentation Controls (31 25 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.

1.3 WORK INCLUDED

A. The Contractor shall, under this item, furnish all material, tools, labor, and equipment necessary to properly conduct excavation at specified locations or as directed by CUMMING UTILITIES.

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.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 EXPLORATORY EXCAVATION

A. When directed by CUMMING UTILITIES, the Contractor shall perform field exploratory excavation work to determine the presence of existing underground sanitary sewer, water, and storm drainage, utility piping, and or structures. The information for each said utility

found shall include, but not limited to, type of utility, material dimension, material type, and both vertical and horizontal measurements of its location.

B. Where necessary, utilize vacuum excavation equipment to minimize the risk of damage to suspected existing utilities.

C. Follow all federal, state, and local regulations related to excavation work.

D. For each utility found, provide the following information:

1. Type of utility
2. Material type
3. Material dimension
4. Measurements of the vertical and horizontal location of the utility to permanent reference points
5. Any other information which may help in coordinating work around the utility

E. Submit documentation of the findings, including a detailed sketch, to the Engineer and CUMMING UTILITIES.

END OF SECTION 02 32 19

SECTION 02 41 13.13
PAVING REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Equipment
3.1	Trench Paving Removal
3.2	Milling Operation

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. Forsyth County Department of Transportation Standard Specifications.

1.3 WORK INCLUDED

A. The Contractor shall furnish all materials, tools, labor, and equipment, necessary to remove asphalt and/or concrete paving as required for the installation of proposed water mains or sewer mains and related appurtenances under the Contract and as directed by CUMMING UTILITIES.

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.

B. The Contractor shall submit photographs and/or videotape, sufficiently detailed, of existing conditions of project site. These shall be used to evaluate project areas that might be misconstrued as damage caused by debris, or construction material removal.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. MILLING EQUIPMENT:

1. Use power-driven, self-propelled milling equipment that is the size and shape that allows traffic to pass safely through areas adjacent to the work. Also use equipment that is:
    a. Designed to mill and remove specified depth of existing asphalt and/or concrete paving.
    b. Equipped with grade slope controls operating from a string line or ski and based on mechanical or sonic operation.
    c. Capable of removing pavement to an accuracy of 1/8 in. (3 mm).
    d. Furnished with lighting system for night work, as necessary.
    e. Provided with conveyors capable of side, rear, or front loading to transfer the milled material from the roadway to a truck.

B. DUST CONTROL

1. Provide power brooms, vacuum sweepers, power blowers, or other means to remove loose debris or dust. Do not allow dust control to restrict visibility of passing traffic or to disrupt adjacent property owners.

PART 3 - EXECUTION

3.1 TRENCH PAVING REMOVAL

A. Where trench excavation within a paved surface is required, the Contractor shall saw cut in a straight line, vertical joints for the entire depth of pavement. The saw cut joints shall extend for the entire length of trench on both sides of the trench. Ragged edges shall be trimmed so as to provide a substantially straight line juncture between the old and new surfaces.

B. The saw cut joints shall be a minimum of twelve inches (12”) outside of the maximum width of excavated trench.

C. Pavement shall be removed and hauled off site and disposed of in a proper legal manner. Contractor shall be careful not to disturb or damage any pavement that is to remain.

3.2 MILLING OPERATION

A. Follow the Plans to mill the designated areas and depths, as required. Ensure the following requirements are met:

1. Schedule the construction operation. Use milling methods that will produce a uniform finished surface and maintain a constant cross slope between extremities in each lane.
2. Provide positive drainage to prevent water accumulation on the milled pavement, as shown on the Plans or directed by the Engineer.
3. Bevel back the longitudinal vertical edges greater than 2 in (50 mm) that are produced by the removal process and left exposed to traffic. Bevel them back at

least 3 in for each 2 in (75 mm for each 50 mm) of material removed. Use an attached mold board or other approved method.

4. When removing material at ramp areas and ends of milled sections, taper the transverse edges 10 ft (3 m) to avoid creating a traffic hazard and to produce a smooth surface.

5. Protect with a temporary asphaltic concrete tie-in (paper joint) vertical edges at other areas such as bridge approach slabs, drainage structures, and utility appurtenances greater than ½-inch that are left open to traversing vehicles. Place the temporary tie-in at taper rate of at least 6 to 1 horizontal to vertical distance.

6. Remove dust, residue, and loose milled material from the milled surface. Do not allow traffic on the milled surface and do not place asphaltic concrete on the milled surface until removal is complete.

B. The reclaimed asphaltic and/or concrete pavement becomes the Contractor's property unless otherwise specified.

END OF SECTION 02 41 13.13

SECTION 02 41 13.23
UTILITY LINE REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Equipment
3.1	Trench Paving Removal
3.2	Milling Operations
3.3	Pipe Removal/Abandonment
3.4	Valve Abandonment
3.5	Fire Hydrant Removal
3.6	Manhole Removal/Abandonment

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.

1.3 WORK INCLUDED

A. The Contractor shall furnish all materials, tools, labor, and equipment, necessary to remove and/or abandon existing utility lines as required for the installation of proposed utility pipelines and related appurtenances under the Contract and as directed by CUMMING UTILITIES.

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.

B. The Contractor shall submit photographs and/or videotape, sufficiently detailed, of existing conditions of project site. These shall be used to evaluate project areas that might be misconstrued as damage caused by debris, or construction material removal.

C. The Contractor shall submit for approval by the Engineer and CUMMING UTILITIES:
   1. Details of all caps or plugs to be installed on abandoned piping to remain in the ground.
   2. Details for restraining all existing water mains to remain in services where a portion of the main has been removed or modified.
   3. Location of disposal site for all materials removed with documentation from site owner stating acceptance of each type of material to be disposed of.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Milling Equipment

1. Use power-driven, self-propelled milling equipment that is the size and shape that allows traffic to pass safely through areas adjacent to the work. Also use equipment that is:
   a. Designed to mill and remove specified depth of existing asphalt paving
   b. Equipped with grade slope controls operating from a string line or ski and based on mechanical or sonic operation
   c. Capable of removing pavement to an accuracy of 1/8 in. (3 mm)
   d. Furnished with lighting system for night work, as necessary
   e. Provided with conveyors capable of side, rear, or front loading to transfer the milled material from the roadway to a truck.

B. Dust Control Equipment

2. Provide power brooms, vacuum sweepers, power blowers, or other means to remove loose debris or dust. Do not allow dust control to restrict visibility of passing traffic or to disrupt adjacent property owners.

PART 3 - EXECUTION

3.1 TRENCH PAVING REMOVAL

A. Where trench excavation within a paved surface is required, saw cut vertical joints for the entire depth of pavement. The saw cut joints shall extend for the entire length of trench on both sides of the trench. Ragged edges shall be trimmed so as to provide a substantially straight line juncture between the old and new surfaces.

B. The saw cut joints shall be a minimum of 12 inches outside of the maximum width of excavated trench.

C. Pavement shall be removed, hauled off site and disposed of in a proper legal manner. Be careful not to disturb or damage any pavement that is to remain.

3.2 MILLING OPERATION

A. Follow the Plans to mill the designated areas and depths, as required. Ensure the

following requirements are met:

1. Schedule the construction operation. Use milling methods that will produce a uniform finished surface and maintain a constant cross slope between extremities in each lane.

2. Provide positive drainage to prevent water accumulation on the milled pavement, as shown on the Plans or directed by the Engineer.

3. Bevel back the longitudinal vertical edges greater than 2 in (50 mm) that are produced by the removal process and left exposed to traffic. Bevel them back at least 3 inches for each 2 inches (75 mm for each 50 mm) of material removed. Use an attached mold board or other approved method.

4. Remove dust, residue, and loose milled material from the milled surface. Do not allow traffic on the milled surface and do not place asphaltic concrete on the milled surface until removal is complete.

B. The reclaimed asphaltic pavement becomes the Contractor's property unless otherwise specified.

3.3 PIPE REMOVAL/ABANDONMENT

A. The Contractor shall be responsible for removal of any existing utility pipeline that is to be abandoned that interferes with the installation of the proposed pipelines. Prior to removing any portion of existing pipelines, the Contractor shall obtain approval from CUMMING UTILITIES.

B. The Contractor shall isolate the portion of the pipeline to be removed using existing isolation valves. Any service connections on the pipeline to be removed shall be transferred to the new pipeline or an existing pipeline which will remain in service, prior to isolation of the pipeline.

C. The ends of piping to remain in the ground shall be suitably capped or plugged to prevent water or soil from entering the pipe.

D. Any existing pipelines that have a portion of pipe removed and are to remain in service shall be properly restrained with thrust blocking to prevent movement of the remaining pipe.

E. The Contractor shall follow all applicable codes and regulations for removal of hazardous materials, such as asbestos cement pipe, and dispose of in a legal and proper manner.

F. The Contractor shall load, haul away, and dispose of material in a legally permitted location, any debris, trash, structures, piping, etc. removed from the worksite.

3.4 VALVE ABANDONMENT

A. Buried valves that are to be abandoned shall be fully closed. The valve box shall be removed, and the hole filled with suitable material and compacted. If the valve is within a paved location, the hole shall be capped with matching materials (asphalt, concrete, etc.). If the valve is at the end of a water main that is to remain in service, the valve shall be plugged and restrained to prevent leaks.

3.5 FIRE HYDRANT REMOVAL

A. Fire hydrants to be removed shall be salvaged in accordance with Section 33 12 19.81 entitled “Relocate and Reconnect Hydrants, Valves, and Meters” of these specifications.

3.6 MANHOLE REMOVAL/ABANDONMENT

A. The Contractor shall be responsible for removal of any existing manhole that is to be abandoned that interferes with the installation of the proposed sewer or force main. Prior to removing any manholes, the Contractor shall obtain approval from CUMMING UTILITIES.

B. Where manholes are to be removed, the Contractor shall excavate the manhole; remove the manhole and connecting piping, as required, backfill and compact the void with approved material. If the manhole is located within a road, parking area, driveway or other paved area, the backfill shall be compacted to at least 95% of maximum dry density - Standard Proctor (ASTM D698). If the manhole is located in an unpaved area, the backfill shall be compacted to 85% of maximum dry density - Standard Proctor (ASTM D698), and slightly mounded to allow for settlement.

C. Where manholes are to be abandoned in place, the Contractor shall grout seal the ends of all pipes entering the manhole, fracture the invert of the manhole to allow for drainage, cut the top of the manhole off to a minimum of three feet (3’) below finished grade, fill the manhole with #57 stone, and backfill and compact with suitable fill material. If the manhole is located within a road, parking area, driveway or other paved area, the backfill shall be compacted to at least 95% of maximum dry density - Standard Proctor (ASTM D698). If the manhole is located in an unpaved area, the backfill shall be compacted to 85% of maximum dry density - Standard Proctor (ASTM D698), and slightly mounded to allow for settlement.

END OF SECTION 02 41 13.23

SECTION 02 42 11
REMOVAL OF CONSTRUCTION MATERIAL

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
3.1	Workmanship

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.

1.3 WORK INCLUDED

A. The Contractor shall furnish all materials, tools, labor, and equipment, necessary to remove all unwanted construction material and debris, as directed by CUMMING UTILITIES.

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.

B. The Contractor shall supply identification and license of company hauling/transporting material from the site.

C. The Contractor shall submit photographs and/or videotape, sufficiently detailed, of existing conditions of project site. These shall be used to evaluate project areas that might be misconstrued as damage, caused by debris, or construction material removal.

PART 2 - PRODUCTS – (NOT USED)

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. The Contractor shall follow all federal, state, and local regulations related to removal, hauling, and disposal of trash and debris.

B. The Contractor shall comply with Forsyth County Ordinance SWO 2012-002 for hauling and disposal of all solid waste removed from the site for the duration of the Work.

C. The Contractor shall load, haul away, and dispose of debris, trash, structures, automobiles, etc., that may be pre-existing on the Worksite, to a legally permitted location.

D. The Contractor shall load, haul away, and dispose of construction material that is generated in execution of the Work, to a legally permitted location; including, but not limited to any debris, trash, structures, piping, etc.

E. The Contractor shall remove and dispose of all unused construction materials prior to Final Acceptance of the Work by CUMMING UTILITIES and the Engineer.

F. No additional payment shall be made for excavation or disposal of excavated material required for placement or removal of backfill placed above the foundation of the pavement; or for preparation of subgrade. The cost thereof shall be considered included in the pavement unit prices bid.

END OF SECTION 02 42 11

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Form-facing material for cast-in-place concrete.
   2. Bracing and anchoring.

1.2 DEFINITIONS

A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:
   1. Exposed surface form-facing material.
   2. Concealed surface form-facing material.
   3. Form ties.
   4. Waterstops.
   5. Form-release agent.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, brace, and maintain formwork in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:
   1. Provide continuous, true, and smooth concrete surfaces.
   2. Furnish in largest practicable sizes to minimize number of joints.
   3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
      a. Plywood or other approved panel materials.
      b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
         1) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
   1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

2.4 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
   1. Profile: Flat dumbbell without center bulb.
   2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets], for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat dumbbell without center bulb.
   2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat dumbbell without center bulb.

2. Dimensions: 4 inches by 3/16 inch thick; nontapered.

D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.5 RELATED MATERIALS

A. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

D. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:
1. Surface Finish-1.0: ACI 117 Class D, 1 inch.
2. Surface Finish-3.0: ACI 117 Class B, 1/4 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.
1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
   1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
   2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
   1. Provide and secure units to support screed strips
   2. Use strike-off templates or compacting-type screeds.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
   1. Determine sizes and locations from trades providing such items.
   2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

K. Construction and Movement Joints:
   1. Construct joints true to line with faces perpendicular to surface plane of concrete.
   2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   3. Place joints perpendicular to main reinforcement.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

   1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
   2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

M. HClean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
   3. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
   4. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

   1. Install in longest lengths practicable.
   2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
   3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
   4. Secure waterstops in correct position at 12 inches (305 mm) on center.
   5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

      a. Miter corners, intersections, and directional changes in waterstops.

   6. Clean waterstops immediately prior to placement of concrete.
   7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

   1. Install in longest lengths practicable.
   2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
   3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

A. Formwork that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work.
   1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
   2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

END OF SECTION 03 10 00

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete.

B. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings or in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 INSTALLATION TOLERANCES

A. Comply with ACI 117.

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:
1. Section 031000 "Concrete Forming and Accessories" for form-facing materials.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars.
3. Section 312000 "Earth Moving" for drainage course under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with teleconference option.
1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Structural Engineer.
f. Owner representative.

2. Review the following:
a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction joints, control joints, isolation joints, and joint-filler strips.
c. Semirigid joint fillers.
d. Vapor-retarder installation.
e. Anchor rod and anchorage device installation tolerances.
f. Cold and hot weather concreting procedures.
g. Concrete finishes and finishing.
h. Curing procedures.

i. Forms and form-removal limitations.
j. Steel-reinforcement installation.
k. Methods for achieving specified floor and slab flatness and levelness.
l. Floor and slab flatness and levelness measurements.
m. Concrete repair procedures.
n. Concrete protection.
o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
p. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.
1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:

a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Vapor retarders.
8. Liquid floor treatments.
9. Curing materials.
10. Joint fillers.
11. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
9. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.

5. Final finish for floors.
6. Curing process.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:
   1. Installer: Include copies of applicable ACI certificates.
   2. Ready-mixed concrete manufacturer.
   3. Laboratory testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Curing compounds.
   4. Vapor retarders.
   5. Semirigid joint fillers.
   6. Joint-filler strips.
   7. Repair materials.

C. Material Test Reports: For the following, from a qualified testing agency:
   1. Portland cement.
   2. Fly ash.
   3. Slag cement.
   4. Blended hydraulic cement.
   5. Performance-based hydraulic cement.
   6. Aggregates.
   7. Admixtures.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

E. Research Reports:
   1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.

F. Preconstruction Test Reports: For each mix design.

G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
   1. Post-Installed Concrete Anchor Installers: ACI -certified Adhesive Anchor Installer.

B. Ready-Mixed 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 in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
1. Include the following information in each test report:
a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:
   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   3. Obtain aggregate from single source.
   4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I/II.
   2. Fly Ash: ASTM C618, Class F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, portland-limestone cement.
   5. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: Type GU, general use.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Alkali-Silica Reaction: Comply with one of the following:
      a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
      b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
      c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
   2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   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.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
1. Color:
   a. Ambient Temperature Below 50 deg F: Black.
   b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
   c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: 8-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

E. Water: Potable or complying with ASTM C1602/C1602M.

F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

G. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent by mass.
   2. Slag Cement: 50 percent by mass.
   3. Total of Fly Ash or Other Pozzolans, and Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

2.9 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings.
   1. Exposure Class: ACI 318 – F2; W0; C1.
   2. Minimum Compressive Strength: As indicated at 28 days.
   3. Maximum w/cm: 0.50.
   4. Slump Limit: 4 inches, plus or minus 1 inch.
   5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
   6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

B. Class B: Normal-weight concrete used for interior slabs-on-ground, trench slab, and equipment housekeeping pads.
   1. Exposure Class: ACI 318 – F0; W0; C0.
   2. Minimum Compressive Strength: As indicated at 28 days.
   3. Maximum w/cm: 0.45.
   4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
   5. Slump Limit: 4 inches, plus or minus 1 inch.
   6. Air Content:
      a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
   7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

C. Class C: Normal-weight concrete used for trench and building walls.

   1. Exposure Class: ACI 318 - F2;W0;C1.
   2. Minimum Compressive Strength: As indicated at 28 days.
   3. Maximum w/cm Ratio: 0.50.
   4. Slump Limit: 4 inches, plus or minus 1 inch.
   5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
   6. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Class D: Normal-weight concrete used for exterior slabs-on-ground and equipment pads.
   1. Exposure Class: ACI 318 – F2; W0; C1.
   2. Minimum Compressive Strength: As indicated at 28 days.
   3. Maximum w/cm: 0.50.
   4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
   5. Slump Limit: 4 inches, plus or minus 1 inch.
   6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
   7. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
   2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
   1. Daily access to the Work.
   2. Incidental labor and facilities necessary to facilitate tests and inspections.
   3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
   4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
   1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
   1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
   2. Face laps away from exposed direction of concrete pour.
   3. Lap vapor retarder down onto perimeter masonry walls not less than 6 inches, sealing vapor retarder to concrete.
   4. Lap joints 6 inches and seal with manufacturer's recommended tape.

5. Terminate vapor retarder as shown at the edge of floor slabs, sealing entire perimeter to foundation walls.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.5 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.
    a. Continue reinforcement across construction joints unless otherwise indicated.
3. Form keyed joints as indicated. Embed keys at least 1 1/2 inches into concrete.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints as indicated and as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
   1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
   2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and Special Inspector 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
   1. If a section cannot be placed continuously, provide construction joints as indicated.
   2. Deposit concrete to avoid segregation.
   3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
   4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
      a. Do not use vibrators to transport concrete inside forms.
      b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
      c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
      d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Do not place concrete floors and slabs in a checkerboard sequence.
   2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   3. Maintain reinforcement in position on chairs during concrete placement.
   4. Screed slab surfaces with a straightedge and strike off to correct elevations.
   5. Level concrete, cut high areas, and fill low areas.
   6. Slope surfaces uniformly to drains or workpoints where required.
   7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
   8. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:
   1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
      a. Patch voids larger than 1 1/2 inches wide or 1/2 inch deep.
      b. Remove projections larger than 1 inch.
      c. Tie holes do not require patching.
      d. Surface Tolerance: ACI 117 Class D.
      e. Apply to concrete surfaces not exposed to public view.

   2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
      a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
      b. Remove projections larger than 1/4 inch.
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 Class B.
      e. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete.

B. Related Unformed Surfaces:
   1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth, and finish with a color and texture matching adjacent formed surfaces.
   2. Continue final surface treatment of formed surfaces uniformly across adjacent surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:
   1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
   2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
   3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:
   1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
   2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
   3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   4. Do not add water to concrete surface.
   5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

6. Apply a trowel finish to interior slab surfaces exposed to view unless otherwise noted.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
    a. Slabs on Ground:
        1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

D. Broom Finish: Apply a broom finish to exterior concrete slabs, paving, sidewalks, and locations indicated on Drawings.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:
1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.

c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
    1) Recoat areas subject to heavy rainfall within three hours after initial application.
    2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:
    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.
        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
            a) Water.
            b) Continuous water-fog spray.

    b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
   a) Water.
   b) Continuous water-fog spray.

c. Floors to Receive Curing Compound:
   1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
   2) Recoat areas subjected to heavy rainfall within three hours after initial application.
   3) Maintain continuity of coating, and repair damage during curing period.
   4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

d. Floors to Receive Curing and Sealing Compound:
   1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
   2) Recoat areas subjected to heavy rainfall within three hours after initial application.
   3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

A. Conform to ACI 117.

3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Comply with manufacturer's direction regarding age of concrete.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface has received a float finish or abrasive surface preparation.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s).

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
   a. Limit cut depth to 3/4 inch.
   b. Make edges of cuts perpendicular to concrete surface.
   c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
   d. Fill and compact with patching mortar before bonding agent has dried.
   e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
   a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
   b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
   a. Correct low and high areas.
   b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that

penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
    a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
    a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
    b. Feather edges to match adjacent floor elevations.
6. Correct other low areas scheduled to remain exposed with repair topping.
    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:
1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Steel-reinforcement placement.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Batch Plant Inspections: On a random basis, as determined by Architect.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain a minimum of three composite samples for each day's pour of each concrete mixture.
    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:

a. 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.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
   a. 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:
   a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
   a. Cast and laboratory cure two sets of three 6-inch by 12-in or 4-inch by 8-inch cylinder specimens for each composite sample.
   b. When cold- or hot-weather procedures are used, cast, initial cure, and field cure two companion sets of three cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
   a. Test one set of three laboratory-cured specimens at seven days and one set of three specimens at 28 days.
   b. If used, test one set of three field-cured companion specimens at seven days and one set of three specimens at 28 days.
   c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor must inform Owner, evaluate operations, and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every 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 by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
9. 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.
10. Additional Tests:
    a. Testing and inspecting agency to 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.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
       1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
11. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor slab flatness/levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

3.16 PROTECTION

A. Protect concrete surfaces as follows:
   1. Protect from petroleum stains.
   2. Diaper hydraulic equipment used over concrete surfaces.
   3. Prohibit vehicles from interior concrete slabs.
   4. Prohibit use of pipe-cutting machinery over concrete surfaces.
   5. Prohibit placement of steel items on concrete surfaces.
   6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION 03 30 00

SECTION 03 61 00

FLOWABLE BACKFILL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish flowable backfill as indicated in the construction documents.

1.02 RELATED DOCUMENTS

Drawings and general provisions of Contract, including General Conditions, Supplemental Conditions apply to work of this section.

PART 2 - PRODUCTS

2.01 DESCRIPTION

A controlled-low-strength-material that has a specified compressive strength of 500 pounds per square inch (PSI) or less at 28 days. This material is not concrete and is in a flowable state at the time of placement.

2.02 GENERAL

A. A flowable backfill mixture consists of water, Portland Cement, Type “F,” fly ash and fine aggregate.

B. If fly ash is not used, flowable backfill may be produced using high dosages of an air entraining admixture to help flowability and lower strength for removability.

2.03 CEMENTITIOUS MATERIALS

Cement shall be Type I or II Portland Cement conforming to ASTM C-150 and Type “F” fly ash.

2.04 AGGREGATES

Fine aggregates conforming to ASTM C 33 shall be used in flowable backfill.

2.06 MIX DESIGN

A. The proportion of materials used in flowable backfill shall be as follows:

Material	Quantity
Cement	50 pounds (lbs) per cubic yard (cy)

Type “F”, Fly Ash	150 lbs/cy
Sand	2800-3200 lbs/cy
Water	400-500 lbs/cy

B. Other proportions may be used upon approval of the Engineer.

C. The mixture used shall conform to the following flowability.

A 3-inch diameter by 6-inch long open-ended cylinder will be filled with the mixture, then struck off to level. The cylinder will be removed by pulling straight up and the diameter of the flowable backfill, after spreading, must be a minimum of 8-inches.

D. Compressive strength specimens will be made and tested for strength on a random basis as directed by the Engineer.

PART 3 - EXECUTION

3.01 MIXING AND TRANSPORTATION

A. Flowable backfill must be transported by mixer truck. Agitation is required at all times from mixing to placement.

END OF SECTION 03 61 00

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Lintels.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Accessories.
7. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:

1. Cavity wall insulation adhered to masonry backup.

C. Related Requirements:

1. Section 031000 – “Concrete Forms and Accessories” for dovetail or channel slots for masonry-veneer anchors.
2. Section 044300 - “Stone Masonry” for stone masonry veneer and flashing.
3. Section 072726 - “Fluid-Applied Membrane Air Barriers” for barriers applied to unit masonry assemblies.
4. Section 072100 – “Thermal Insulation” for cavity wall insulation.
5. Section 099600 – “High-Performance Coatings” for coatings applied to masonry.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PRE-INSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site with teleconference option.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of the following:

1. Masonry units.

a. Include data on material properties.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 MOCKUPS

A. Sample Panel Mockups: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior wall in sizes approximately 60 inches long by 60 inches high by full thickness.
2. Build sample panels facing south.
3. Protect approved sample panels from the elements with weather-resistant membrane.
4. Approval of sample panels is for texture and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units, cementitious mortar components, and mortar aggregate from single source.

B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

2.3 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90, lightweight.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

2.4 LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Cement: ASTM C1329/C1329M.

F. Preblended Dry Mortar Mix: Packaged blend made from portland cement and hydrated lime, masonry cement, or mortar cement, sand, and admixtures and complying with ASTM C1714/C1714M.

G. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

H. Aggregate for Grout: ASTM C404.

I. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
5. Provide in lengths of not less than 10 ft., with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.

2.7 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

2.8 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide Type S mortar.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.

3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft., 3/8 inch in 20 ft., or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft., or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing or cavity wall insulation unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry or offset angle support lintels where indicated and where openings of more than 12 inches are required.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY

A. Placing Reinforcement: Comply with requirements in TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Frequency: One set of tests for each 1000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

F. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.

2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 04 21 13

BRICK MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Brick
2.2	Mortar
3.1	Brick
3.2	Laying
3.3	Mortar

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Cast-in-Place Concrete (03 30 00).
2. Precast Concrete Utility Structures (33 05 16.13).
3. Utility Pipe Jacking (33 05 23.16).

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.

1.3 WORK INCLUDED

A. The Contractor shall, under this item, furnish all materials, tools, labor, and equipment, necessary to fully complete the Work indicated under this Contract and as directed by CUMMING UTILITIES.

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.

B. Submittals shall show in detail the type, size, and location of all brick masonry and accessories to be used in construction. Submittals shall include material properties data and mortar mix design.

PART 2 - PRODUCTS

2.1 BRICK

A. All brick used shall, unless otherwise shown or specified, be of such quality as to meet ASTM Designation C62.

B. Subject to compliance with requirements, provide the following or an approved equal:
   1. Grade SW hard grade, common, building brick of clay or shale 2-¼ x 3-¾ x 8 inches in size.

2.2 MORTAR

A. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type 'S.'

C. Aggregate for Mortar: ASTM C144, except for joints less than ¼ inch thick, use aggregate graded with 100 percent passing the No.16 sieve.
   1. White-Mortar Aggregates: Natural white sand or ground white stone.

PART 3 - EXECUTION

3.1 BRICK

A. Should brick be brought upon the site of the Work, of which only a portion is of acceptable quality, the Contractor shall at once remove the same and shall not offer that material again for inspection.

3.2 LAYING

A. The brick shall be laid regularly and truly to line with joints not exceeding one-quarter (¼) inch in thickness on the face and with joints completely filled with mortar as each brick is pushed into place and no subsequent filling of said joints shall be allowed. No bats or imperfect bricks shall be permitted to be used.

B. The exposed faces of the brick masonry shall have all mortar projecting beyond the surface of the brick scraped off and the brickwork shall be thoroughly cleaned, and the joints pointed immediately after placing.

C. No broken or cut brick shall be allowed to be used, except where necessary, as closures, and where cutting of bricks is necessary. Then such faces as are exposed in the same must be accurately trimmed to the contour of the face of the Work in which the bricks are laid.

D. All brickwork shall be bonded as may be directed and adjoining courses shall break joint one-half (½) a brick as nearly as practicable. The brickwork shall be executed straight and vertical or regularly curved or battered as shown or specified. Whenever brick masonry is left for the night, or is left unfinished for any reason, the masonry shall be racked off or toothed as directed and mortar removed from the exposed surfaces of

the bricks. When new Work is joined to Work previously laid, the old brickwork must first be thoroughly scraped free from adhering mortar or earth, and thoroughly washed with water.

3.3 MORTAR

A. The brick shall be laid in mortar consisting of one (1) part by volume of Portland Cement and two (2) parts by volume of clean, coarse, screened sand, thoroughly mixed dry, with sufficient water afterwards added slowly to give proper consistency. Twenty (20) pounds of lime per sack of cement may be added.

END OF SECTION 04 21 13

SECTION 04 43 00

STONE MASONRY

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 the following applications of stone masonry:
   1. Anchored to unit masonry backup.

1.3 ACTION SUBMITTALS

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

   1. For stone varieties proposed for use on Project, include test data indicating compliance with physical properties required by referenced ASTM standards.

B. Samples for Initial Selection: For colored mortar and other items involving color selection.

C. Samples for Verification:

   1. For each stone type indicated. Include at least three samples in each set for each type of stone, exhibiting extremes of the full range of color and other visual characteristics expected in completed Work. Samples will establish the standard by which stone provided will be judged.
   2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, sources of supply, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

B. Source Limitations for Stone: Obtain stone, from one quarry with resources to provide materials of consistent quality in appearance and physical properties.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for typical exterior wall n sizes approximately 96 inches (2400 mm) long by full height, by full thickness, including face and backup wythes and accessories.

    a. Include stone coping at top of mockup.
    b. Include a sealant-filled joint at least 16 inches (400 mm) long in mockup.
    c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of mockup with a 12-inch (300-mm) length of flashing left exposed to view (omit stone masonry above half of flashing).
    d. Include veneer anchors, flashing, and weep holes in exterior masonry-veneer wall mockup.

3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of stone; relationship of mortar and sealant colors to stone colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities Architect specifically approves in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.

B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone masonry.

1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.8 COORDINATION

A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry.

PART 2 - PRODUCTS

2.1 STONE

A. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 GRANITE

A. Granite: Comply with ASTM C 615.

B. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Colored Cement Product: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Pigments shall not exceed 5 percent of mortar cement by weight.
4. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Colored Mortar Cement:

        1) Lafarge North America; Magnolia Superbond Mortar Cement.
        2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Mortar Cement.

D. Aggregate: ASTM C 144 and as follows:

1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
2. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

    a. Match Architect's sample.

E. Water: Potable.

2.4 VENEER ANCHORS

A. Materials:
1. Hot-Dip Galvanized-Steel Sheet: ASTM A 1008/A 1008M, cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M, Class B-2.

B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches (38 mm), through stone masonry and with at least 5/8-inch (16-mm) cover on outside face.

C. Corrugated-Metal Veneer Anchors: Not less than 0.030-inch- (0.76-mm-) thick by 7/8-inch- (22-mm-) wide hot-dip galvanized-steel sheet with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 13 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm).

D. Polymer-Coated, Steel Tapping Screws for Concrete Masonry: Self-tapping screws with specially designed threads for tapping and wedging into masonry, with hex washer head and neoprene washer, 3/16-inch (4.8-mm) diameter by 1-1/2-inch (38-mm) length, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

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. ITW-Buildex; Tapcon.
    b. Powers Fasteners; Tapper.

2.5 STONE TRIM ANCHORS

A. Stone Trim Anchors: Units fabricated with tabs or dowels designed to engage kerfs or holes in stone trim units and holes for fasteners or postinstalled anchor bolts for fastening to substrates or framing as indicated.

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. Halfen Anchoring Systems; Meadow Burke.
b. Heckmann Building Products Inc.
c. Hohmann & Barnard, Inc.

B. Materials: Fabricate anchors from stainless steel, ASTM A 240/A 240M, Type 304. Fabricate dowels from stainless steel, ASTM A 276, Type 304.

C. Fasteners for Stone Trim Anchors: Annealed stainless-steel bolts, nuts, and washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

D. Postinstalled Anchor Bolts for Fastening Stone Trim Anchors: Chemical anchors, torque-controlled expansion anchors or undercut anchors made from stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.4 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.6 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel with ribs at 3-inch (75-mm) intervals along length of flashing to provide an integral mortar bond.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Cheney Flashing Company; Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth)].
2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.

4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.
7. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (75 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
8. Metal Drip Edges: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees[and hemmed].
9. Metal Flashing Terminations: Fabricate from stainless steel. Extend at least 3 inches (75 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 3/8 inch (10 mm) to form a stop for retaining sealant backer rod.
10. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: For flashing not exposed to the exterior, use one of the following unless otherwise indicated:

1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy as follows:
   a. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.6 mm) thick, with a 0.015-inch- (0.4-mm-) thick coating of rubberized-asphalt adhesive.
   b. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch (0.6 mm) thick, with a 0.015-inch- (0.4-mm-) thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches (38 mm) from edge.

      1) Color: Gray.

   c. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
   d. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Hyload, Inc.; Hyload Cloaked Flashing System.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Adhesives, Primers, and Seam Tapes for Flexible Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Cementitious Dampproofing: Cementitious formulations that are recommended by ILI and that are nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.

C. Asphalt Dampproofing: Cut-back asphalt complying with ASTM D 4479, Type I or asphalt emulsion complying with ASTM D 1227, Type III or IV.

D. Weep Hole/Vent Products: Use one of the following unless otherwise indicated:
1. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch (10-mm) OD by thickness of stone masonry.
2. Rectangular Plastic Tubing: Clear butyrate, 3/8 by 1-1/2 inches (10 by 38 mm) by thickness of stone masonry.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:
   a. Sheets or strips full depth of cavity and installed to full height of cavity.

2. 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 Building Products Inc.; Mortar Break II.
   b. CavClear/Archovations, Inc.; CavClear Masonry Mat.

F. Expanded Metal Lath: 3.4 lb/sq. yd. (1.8 kg/sq. m), self-furring, diamond-mesh lath complying with ASTM C 847. Fabricate from structural-quality, zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G60 (Z180).

G. Woven-Wire Lath: ASTM C 1032, fabricated into 1-1/2-inch (38-mm) hexagonal-shaped mesh with minimum 0.0510-inch- (1.3-mm-) diameter, galvanized-steel wire.

H. Welded-Wire Lath: ASTM C 933, fabricated into 2-by-2-inch (50-by-50-mm) mesh with minimum 0.0625-inch- (1.6-mm-) diameter, galvanized-steel wire.

I. Lath Attachment Devices: Material and type required by ASTM C 1063 for installations indicated.

2.8 CAVITY-WALL INSULATION

A. Extruded-Polystyrene Board Insulation with Increased R-Value: ASTM C 578, Type IV, but with an aged thermal resistance (R-value) for 1-inch (25-mm) thickness of 5.6 deg F x h x sq. ft./Btu at 75 deg F (1.0 K x sq. m/W at 24 deg C) at 5 years; closed-cell product with a carbon-black filler and extruded with an integral skin.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

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. Diedrich Technologies, Inc.
b. Dominion Restoration Products.
c. EaCo Chem, Inc.
d. Hydrochemical Techniques, Inc.
e. Prosoco, Inc.

2.10 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride.
2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
4. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Stone Masonry: Comply with ASTM C 270, Proportion Specification.

1. Mortar for Setting Stone: Type N.
2. Mortar for Pointing Stone: Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of mortar cement by weight.
3. Mix to match Architect's sample.

2.11 FABRICATION

A. Fabricate stone to comply with sizes, shapes, and tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.

1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."

B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated.

C. Cut and drill sinkages and holes in stone for anchors and supports.

D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.

1. Clean sawed backs of stone to remove rust stains and iron particles.

E. Thickness of Stone: Provide thickness indicated, but not less than the following:

1. Thickness: 4 inches (100 mm) plus or minus 1/4 inch (6 mm). Thickness does not include projection of pitched faces.

F. Shape stone for type of masonry (pattern) as follows:
1. Sawed-bed, random-range ashlar with random course heights and random lengths (interrupted coursed).

G. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.

1. Finish: As indicated
2. Finish for Sills: Split face with sand-rubbed washes
3. Finish for Copings: Split faces

a. Finish exposed ends of copings same as front and back faces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.

C. Examine wall framing, sheathing, and weather-resistant sheathing paper to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.

B. Coat concrete and unit masonry backup with asphalt dampproofing.

C. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING OF STONE MASONRY, GENERAL

A. Perform necessary field cutting and trimming as stone is set.

1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.
2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or quarry fabricated.
3. Pitch face at field-split edges as needed to match stones that are not field split.

B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

C. Arrange stones in range ashlar pattern with course heights as indicated, [uniform] [random] lengths, and uniform joint widths, with offset between vertical joints as indicated.

D. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.

E. Arrange stones in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.

F. Arrange stones in uncoursed rubble pattern with joint widths within tolerances indicated.

G. Arrange stones in polygonal (mosaic) pattern with uniform joint widths.

H. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.

I. Set stone to comply with requirements indicated on Drawings. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.

J. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with

joints not less than 1/4 inch (6 mm) at narrowest points or more than 3/8 inch (10 mm) at widest points.

K. Provide sealant joints of widths and at locations indicated.

1. Keep sealant joints free of mortar and other rigid materials.
2. Sealing joints is specified in Section 079200 "Joint Sealants."

L. Install metal expansion strips in sealant joints at locations indicated. Build flanges of expansion strips into masonry by embedding in mortar between stone masonry and backup wythe. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.

M. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
1. At concrete backing, extend flashing through stone masonry, turned up a minimum of 8 inches (200 mm), and insert in reglet.
2. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches (150 mm) into masonry at each end.
3. At sills, extend flashing not less than 4 inches (100 mm) at ends.
4. At ends of head and sill flashing turn up not less than 2 inches (50 mm) to form end dams.
5. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
7. Extend sheet metal flashing 1/2 inch (13 mm) beyond face of masonry at exterior and turn flashing down to form a drip.
8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
10. Cut flexible flashing flush with face of wall after masonry wall construction is completed.

N. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.

1. Use round plastic tubing or rectangular plastic tubing to form weep holes.
2. Space weep holes 24 inches (600 mm) o.c.

3. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

O. Install vents in vertical head joints at the top of each continuous cavity at spacing indicated. Use round plastic tubing or rectangular plastic tubing to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.

C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4 inch in 40 feet (19 mm in 12 m) or more.

D. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each stone from level, plumb, or dimensioned plane.

E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.

F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ANCHORED STONE MASONRY

A. Anchor stone masonry to unit masonry with corrugated-metal veneer anchors unless otherwise indicated. Embed anchors in unit masonry mortar joints or grouted cells for distance at least one-half of unit masonry thickness.

B. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 1-1/2 inches (38 mm), through stone masonry and with at least 5/8-inch (16-mm) cover on outside face.

C. Space anchors not more than 16 inches (400 mm) o.c. vertically and 24 inches (600 mm) o.c. horizontally. Install additional anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding 12 inches (300 mm).

D. Anchor stone trim with stone trim anchors where indicated. Install anchors by fastening to substrate and inserting tabs and dowels into kerfs and holes in stone units. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.

E. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.

F. Provide 2-inch (50-mm) cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.

1. Place mortar spots in cavity at veneer anchors to maintain spacing.
2. Slope beds toward cavity to minimize mortar protrusions into cavity.
3. Do not attempt to trowel or remove mortar fins protruding into cavity.

G. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm) before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 ADJUSTING AND CLEANING

A. Remove and replace stone masonry of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective joints.
3. Stone masonry not matching approved samples and mockups.
4. Stone masonry not complying with other requirements indicated.

B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.

4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.
6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.7 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches (100 mm) in greatest dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION 04 43 00

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Headed stud connectors.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site, with a teleconference option.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Headed stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Shop primer.
7. Galvanized-steel primer.
8. Etching cleaner.

9. Galvanized repair paint.
10. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and shop-painting applicators.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Headed stud connectors.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Connection designs have been completed and connections indicated on the Drawings.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles, M-Shapes: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.

E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with plain finish.

B. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1 (Type 8.8-1), compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH (ASTM A563M, Class 10S), heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

D. Headed Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Straight.
2. Nuts: ASTM A563 (ASTM A563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
5. Finish: Plain, except use hot dip galvanized at exterior applications.

B. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 (ASTM A563M) heavy-hex carbon steel.
2. Washers: ASTM F436 (ASTM F436M), Type 1, hardened carbon steel.
3. Finish: Plain, except use hot dip galvanized at exterior applications.

2.5 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26, MPI#80, or MPI#134.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2 or SSPC-SP 3.

F. Headed Stud Connectors: Prepare steel surfaces as recommended by manufacturer of headed stud connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize steel elements indicated and steel permanently exposed to the exterior.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces of high-strength bolted, slip-critical connections.
2. Galvanized surfaces unless indicated to be painted.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.
2. SSPC-SP 3.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

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

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened, except where indicated as slip critical.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

C. Headed Stud Connectors: Prepare steel surfaces as recommended by manufacturer of headed stud connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections and test slip-critical bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 05 12 00

SECTION 05 21 00

STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. Special scissor-type steel joists.
3. Steel joist accessories.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Mill Certificates: For each type of bolt.

F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated on Drawings.

1. Use ASD; data are given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:

a. Roof Joists: Vertical deflection of 1/240 of the span.

2.2 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists.
2. Camber joists according to SJI's "Specifications."

3. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

B. Special Scissor-type Steel Joist: Manufactured steel joists according to SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings and as follows:

1. Joist Type: Scissor-type steel joist.
2. End Arrangement: Underslung.
3. Top-Chord Arrangement: Parallel.
4. Slope: As indicated on Drawings.
5. Equip bearing ends of joists with manufacturer's standard sloped shoes.

2.3 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15. Selected primer must have same appearance as primer used for structural steel.

2.4 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Steel bearing plates with integral anchorages are specified in Section 051200 "Structural Steel Framing."

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, (ASTM A563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

D. Welding Electrodes: Comply with AWS standards.

E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil (0.025 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

A. Touchup Painting:

1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

    a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
    b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

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

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 05 21 00

SECTION 05 3 100

STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.

2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

B. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

A. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating.
2. Galvanized- and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 (230), G60 (Z180) zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Gray top surface with white underside.
3. Deck Profile: Type WR, wide rib.
4. Profile Depth: As indicated in Drawings.
5. Design Uncoated-Steel Thickness: As indicated in Drawings.
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

H. Galvanizing Repair Paint: ASTM A780/A780M.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Use mechanical fasteners in lieu of welding to fasten deck. Locate mechanical fasteners as indicated on Drawings and install in accordance with deck manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by mechanically fastening as indicated on Drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals indicated on Drawings and with fasteners indicated on Drawings.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (50 mm) minimum or butted at Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches (300 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

3.5 FIELD QUALITY CONTROL

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

B. Tests and Inspections:

1. Special inspections for cold-formed steel roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

2. Visually inspect deck installation, fastener layout, and coating for compliance with contract documents.

3. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 05 31 00

SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior gable wall framing.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Exterior gable wall framing.
3. Power-actuated anchors.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel framing.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Power-actuated anchors.
3. Mechanical fasteners.
4. Miscellaneous structural clips and accessories.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

    a. Exterior Gable Framing: Horizontal deflection of 1/240 of the wall height.

3. Design exterior gable wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S100 and AISI S240.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S240 for conditions indicated.

B. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As indicated on Drawings.
2. Coating: G60 (Z180).

C. Steel Sheet for Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

2.3 EXTERIOR GABLE WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches (32 mm).

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Gusset plates.
7. End closures.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by screw fastening as standard with fabricator. Wire tying of framing members is not permitted.

    a. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by screw fastening according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by screw fastening. Wire tying of framing members is not permitted.

a. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

3.3 INSTALLATION OF EXTERIOR GABLE WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3.4 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Verify cold-formed framing materials and inspect installation, orientation, and fastening.

B. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 44 00

COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-formed steel roof trusses.

B. Related Requirements:

1. Section 052100 "Steel Joist Framing" for trusslike, steel roof joists.
2. Section 054000 "Cold-Formed Metal Framing" for cold-formed steel studs, joists, and rafters.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Cold-formed steel roof trusses.

B. Product Data Submittals:

1. Cold-formed steel truss materials.
2. Power-actuated fasteners.
3. Mechanical fasteners.

C. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated Design Submittals: For cold-formed steel trusses.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Power-actuated anchors.
3. Mechanical fasteners.

4. Miscellaneous structural clips and accessories.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:

    a. Roof Trusses: Vertical deflection of 1/240 of the span.

C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses comply with the following:

1. Roof Systems: AISI S210.
2. Lateral Design: AISI S213.
3. Roof Trusses: AISI S214.

2.2 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

2.3 COLD-FORMED STEEL ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard C-shaped steel sections.

1. Connecting Flange Width: 1-5/8 inches (41 mm), minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).

2.4 TRUSS ACCESSORIES

A. Fabricate steel-truss accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Power-Actuated Fasteners: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

2.7 FABRICATION OF COLD-FORMED STEEL TRUSSES AND ACCESSORIES

A. Fabricate cold-formed steel trusses and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate trusses using jigs or templates.
2. Cut truss members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel truss members by screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator.

4. Fasten other materials to cold-formed steel trusses by bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace trusses to withstand handling, delivery, and erection stresses. Lift fabricated trusses by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual truss members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel truss to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting trusses and framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF COLD-FORMED STEEL TRUSSES

A. Install bridge, and brace cold-formed steel trusses in accordance with AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.

1. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure.
2. Anchor trusses securely at all bearing points.
3. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's Technical Note 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."

B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.

1. Erect trusses with plane of truss webs plumb and parallel to each other. Align and accurately position trusses at required spacings.
2. Erect trusses without damaging truss members or connections.
3. Fasten cold-formed steel trusses by mechanical fasteners.

    a. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.

D. Truss Spacing: 48 inches (1220 mm).

E. Do not alter, cut, or remove truss members or connections of trusses.

3.3 ERECTION TOLERANCES

A. Install cold-formed steel trusses level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual trusses no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

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

B. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel trusses are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 44 00

SECTION 055000

METAL FABRICATIONS

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:
1. Metal ladders.
2. Ladder safety cages.
3. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."
4. Section 055213 "Pipe and Tube Railings."
5. Section 055300 "Metal Gratings."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
2. Metal ladders.
3. Ladder safety cages.
4. Metal bollards.

B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. Structural Performance of Ladders: ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

F. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

G. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

H. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 Interior Painting.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips

flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3.

B. Steel Ladders:

1. Space siderails 18 inches (457 mm) apart unless otherwise indicated.
2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.

3. Rungs: 3/4-inch- (19-mm-) diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.

6. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch (12 mm) in least dimension.
7. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
8. Galvanize and prime ladders, including brackets.
9. Prime ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet (6 m) o.c. Provide secondary intermediate hoops spaced not more than 48 inches (1200 mm) o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch (6.4-by-100-mm) flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch (6.4-by-50-mm) flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch (4.8-by-38-mm) flat bars secured to each hoop.
4. Prime ladder safety cages, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

C. Fabricate from [1/8-inch (3.2-mm)] [3/16-inch (4.8-mm)] [rolled-steel floor] [abrasive-surface floor] plate with four 1-inch- (25-mm-) diameter holes for water drainage and for lifting.

D. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than [1/2 inch (12 mm)] [3/4 inch (19 mm)] [1 inch (25 mm)] in least dimension.

E. Provide steel angle supports as indicated.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

1. Cap bollards with 1/4-inch- (6.4-mm-) thick steel plate.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.

C. Fabricate internal sleeves for removable bollards from Schedule 40 steel pipe or 1/4-inch (6.4-mm) wall-thickness steel tubing with an OD approximately 1/16 inch (1.5 mm) less than ID of bollards. Match drill sleeve and bollard for 3/4-inch (19-mm) steel machine bolt.

D. Prime bollards with primer specified in Section 099600 "High-Performance Coatings."

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099600 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

C. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 05 52 13

PIPE AND TUBE RAILINGS

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:

1. Steel pipe and tube railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Steel Pipe and Tube Railings:

a. Pisor Industries, Inc.
b. Wagner, R & B, Inc.; a division of the Wagner Companies.

METALS, GENERAL

B. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.3 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as

determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

E. Intermediate Coats and Topcoats: Provide products that comply with Section 099123 "Interior Painting."

2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:
1. By flush bends or by inserting prefabricated flush-elbow fittings.

L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

E. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099600 "High-Performance Coatings" are indicated.
2. Do not apply primer to galvanized surfaces.

F. Shop-Painted Finish: Comply with Section 099600 "High-Performance Coatings."

1. Color: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.

3.5 ADJUSTING AND CLEANING

A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 53 13

BAR GRATINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal bar gratings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural-steel framing system components.

2. Section 055213 “Pipe and Tube Railings” for metal pipe and tube handrails and railings.

1.02 ACTION SUBMITTALS

A. Product Data:

1. Clips and anchorage devices for gratings.

B. Shop Drawings:

1. Include plans, sections, and attachment details.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

B. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

1.04 QUALITY ASSURANCE

A. Weld Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.

1.05 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531.

B. Welded Steel Grating:

1. Grating Mark: As indicated.
2. Traffic Surface: Serrated.
3. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.02 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.03 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.04 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Bars for Bar Gratings: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A510/A510M.

D. Galvanized-Steel Sheet: ASTM A653/A653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

E. Stainless Steel Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M, Type 304.

F. Stainless Steel Bars and Shapes: ASTM A276/A276M, Type 304.

2.05 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Toeplate Height: 4 inches unless otherwise indicated.
3. Toeplate Location: As indicated in drawings, at cut-outs around columns, and around grating penetrations.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.06 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.02 INSTALLATION OF METAL BAR GRATINGS

A. Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.03 REPAIR

A. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 05 5313

SECTION 07 13 00 – PRE-APPLIED/UNDERSLAB WATERPROOFING MEMBRANE

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:
1. Surface preparation.
2. Blindside sheet waterproofing.

B. Related Requirements:
1. Section 03 30 00 – Cast-in-Place Concrete.
2. Section 07 13 26 – Self-Adhering Sheet Waterproofing.
3. Section 07 21 00 – Thermal Insulation.
4. Section 07 92 00 – Joint Sealants.
5. Section 31 23 00 – Excavation and Fill.
6. Section 33 41 00 – Storm Utility Drainage Piping.

1.3 REFERENCES

A. ACI 302.1R.17 – Guide for Concrete Floor and Slab Construction.

B. ASTM C836 - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

C. ASTM D412-06 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.

D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

E. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.

F. ASTM D1434 - Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting.

G. ASTM D1970-01 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.

H. ASTM D5385-93 - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.

I. ASTM E96 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.

J. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

K. ASTM F2130 - Standard Test Method for Measuring Repellency, Retention, and Penetration of Liquid Pesticide Formulation Through Protective Clothing Materials.

L. GSA-PBS 07115 - General Services Administration, Public Building Service - Guide Specification for Elastomeric Waterproofing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Convene meeting minimum of one week prior to commencing work of this section, in accordance with Section 1.7 - Quality Assurance, meeting with manufacturer’s technical representative, general contractor, Structural Engineer, and Civil Engineer to review the installation procedures.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Contractor will provide the proper equipment, manpower, and supervision at the jobsite to install the membrane in compliance with the project plans and specifications.

B. Installation must be carried out by an experienced contractor with an adequate number of skilled personnel, experienced in the application of the blindside membrane applications.

C. Contractor shall maintain a record of the batch numbers of all materials supplied for this project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean, dry area in accordance with manufacturer's instructions.

C. Store adhesive at temperatures of 40 degrees F (4.4 degrees C) and above to facilitate handling.

D. Do not store at temperatures above 90 degrees F (32 degrees C) for extended periods.

E. Protect materials during handling and application to prevent damage or contamination.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

C. Product not intended for uses subject to abuse or permanent exposure to the elements.

D. Ensure concrete is poured within 60 days of membrane application.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, and insulation.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.2 PRE-APPLIED / UNDERSLAB WATERPROOFING MEMBRANE

A. Blindside Waterproofing Membrane, suitable for horizontal or vertical applications, minimum 73 mil (1.85mm) thick, composite sheet membrane comprised of an elastomeric membrane bonded to a minimum seven-ply plasmatic matrix and a non-woven geotextile fabric.

B. Subject to compliance with requirements, provide one of the following products:
1. Basis for Design: PRECON Waterproofing System by W.R. Meadows, Inc.
2. Aussie Skin 550G by AVM Industries.
3. MiraPLY-H by Carlisle Companies, Inc.
4. MiraPLY-V by Carlisle Companies, Inc.
5. CORFLEX 60 by CETCO.
6. Preprufe 300 by GCP Applied Technologies.
7. Blueskin WP200 by Henry (Carlisle Companies, Inc.).
8. Colphene BSW-V by Soprema.
9. Colphene BSW-H by Soprema.

C. Blindside waterproofing membrane shall have the following performance characteristics, as verified by laboratory testing:
1. Membrane Thickness: 73 mil (1.85 mm).
2. Low Temperature Flexibility, ASTM D1970: Pass.
3. Resistance to Hydrostatic Head, ASTM D5385-93: 230 ft. (70 m).
4. Elongation, ASTM D412-06: >400 percent.
5. Tensile Strength (film), ASTM D882: 9,200 psi (63.4 MPa).
6. Crack Cycling, ASTM C836: Pass.
7. Puncture Resistance, ASTM E154: >210 lb. (>934 N).
8. Peel Adhesion to Concrete, ASTM D903: 10 lb./in (1,754 N/m).
9. Moisture Vapor Transmission, ASTM E96 (Method B): 0.0011 perms.
10. Resistance to Penetration by Pesticides, ASTM F2130, Percentage of Penetration: 0.0 percent.
11. Resistance to Fungi in Soil, GSA-PBS 07115 – 16 weeks: No Effect.
12. Radon Transmittance (m/s), k124/02/95: <3.0 x 10-9.
13. Radon Coefficient (m2/s), k124/02/95: <5.6 x 10-12.
14. Gas Diffusion Coefficient (m2/s), ASTM E96-Procedure B, Modified (solvent-only, no water): >99 percent purity benzene, 1.24 x 10-14; >99 percent purity toluene 8.24 x 10-15; >99 percent purity ethylbenzene 1.24 x 10-15; >99 percent purity trichloroethylene 1.90 x 10-14; 99 percent tetrachloroethylene (PCE/Perc) 3.21 x 10-15; >99 percent purity xylene 1.53 x 10-15.
15. Methane Gas Transmission Rate, mL/day·m2·atm at 74 degrees F (23 degrees C ± 15.5 C) and 50 percent RH ± 10 percent with 99.99 percent methane purity, ASTM D1434 43.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Coordinate all auxiliary materials and accessories to be provided by selected waterproofing manufacturer (Basis for Design products listed below).
2. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Rolled Matrix Drainage System: MEL-DRAIN by W. R. MEADOWS.

C. Liquid Membrane for Fastener Details:
   1. MEL-ROL LIQUID MEMBRANE (two-component) by W. R. MEADOWS.
   2. BEM by W. R. MEADOWS.

D. Liquid Membrane for Overlap Detail: HYDRALASTIC 836 by W. R. MEADOWS.

E. Detail Fabric for Terminations: DETAIL FABRIC by W. R. MEADOWS.

F. Detail Tape Adhesive: MEL-PRIME by W. R. MEADOWS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.

   1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
   2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Inspect all surfaces for any conditions detrimental to the proper completion of the work.

B. Ensure surfaces are structurally sound.

C. Remove debris or any other foreign material that could damage the membrane.

3.3 INSTALLATION

A. Vertical Application
   1. Install the membrane with the fabric side facing the interior side of the form to receive the concrete.
   2. Mechanically fasten membrane across the top lagging at 12 inches (310 mm) on center, ½-inch (12 mm) from the top, with fasteners approved by the manufacturer.
   3. Apply liquid membrane over the areas where the fasteners have been attached and carry over the top edge.
   4. Remove release paper on 6 inches (152.4 mm) factory edge.

5. Mechanically fasten membrane vertically, 24 inches (620 mm) on center, into the exposed factory edge of the membrane if vertical fastening is required.
6. Install subsequent sheet of membrane and overlap onto the 6 inches (152.4 mm) factory edge and roll press into place.
7. For end-to-end overlap, overlap membrane 6 inches (152.4 mm).
8. Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.
9. Apply liquid detail membrane at terminations of membrane, 12 inches (310 mm) wide centered over the termination.
10. Embed detail fabric into this wet liquid detail membrane centered over the termination, 6 inches (152.4 mm) on each side of lap edge, and roll press into place.
11. Apply additional liquid detail membrane on all terminations of detail fabric.
12. Inspect membrane prior to pouring of concrete for any punctures or damage.
13. Repair damaged areas as directed by the manufacturer.

B. Horizontal Application
1. Prepare subgrade prior to membrane application according to ACI 302.1R.17.
2. Ensure the fabric side of the membrane is facing up.
3. Remove release paper on 6 inches (152.4 mm) selvedge edge and overlap edges of additional sheet. Roll press into place.
4. For end-to-end overlap, overlap membrane 6 inches (152.4 mm).
5. Apply liquid detail membrane in this area to be lapped and roll press membrane into this liquid detail membrane.
6. Apply liquid detail membrane at terminations of membrane, 12 inches (310 mm) wide centered over the termination.
7. Embed detail fabric into this wet liquid detail membrane centered over the termination, 6 inches (152.4 mm) on each side of lap edge, and roll press into place.
8. Apply additional liquid detail membrane on all terminations of detail fabric.
9. Inspect membrane prior to pouring of concrete for any punctures or damage.
10. Repair damaged areas as directed by the manufacturer.

3.4 PROTECTION AND CLEANING

A. Prior to placement of concrete on horizontal conditions, remove all nails, screws and sharp objects from the membrane.

B. Ensure membrane is not damaged prior to concrete pour.

C. Ensure concrete is poured within 60 days of membrane application.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 00

SECTION 07 13 26 – SELF-ADHERING SHEET WATERPROOFING

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:

1. Self-adhering sheet polymeric waterproofing membrane.

B. Related Requirements:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 07 21 00 – Thermal Insulation
3. Section 07 92 00 – Joint Sealants

C. REFERENCES

1. American Railway Engineering and Maintenance-of-Way Association (AREMA) Specification Chapter 29 - Waterproofing.
2. ASTM D5385 - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
3. ASTM D146 - Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Fabrics Used in Roofing and Waterproofing.
4. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
5. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
6. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
7. ASTM D1876 – Standard Test Method for Peel Resistance of Adhesives. (T-Peel Test).
8. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
9. ASTM E96 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.
10. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
11. National Roofing Contractors Association – Roofing and Waterproofing Manual.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at project site, at minimum one week prior to commencement of work in this section.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
2. Attendance to include Manufacturer’s technical representative, General Contractor, Structural Engineer, and Civil Engineer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for application, including evaluating, preparing, and treating substrate.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Contractor shall provide appropriate equipment, manpower, and supervision at the project site to install waterproofing in compliance with plans and specifications.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

C. Contractor shall maintain written records of batch numbers for all materials supplied for this project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area in accordance with manufacturer's instructions.

C. Store adhesives and primers at temperatures of 40 degrees F (5 degrees C) and above to facilitate handling.

D. Store membrane cartons on pallets.

E. Do not store at temperatures above 90 degrees F (32 degrees C) for extended periods.

F. Keep away from sparks and flames.

G. Completely cover when stored outside. Protect from rain.

H. Protect materials during handling and application to prevent damage or contamination.

I. Avoid use of products which contain tars, solvents, pitches, polysulfide polymers, or PVC materials that may come into contact with waterproofing membrane system.

1.8 FIELD CONDITIONS

A. Product not intended for uses subject to abuse or permanent exposure to the elements.

B. Protect rolls from direct sunlight until ready for use.

C. Do not apply to frozen concrete.

D. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.
2. Do not apply standard membrane when air or surface temperatures are below 40 degrees F (4 degrees C).

E. Maintain adequate ventilation during preparation and application of waterproofing materials.

F. Ensure concrete is poured within 60 days of membrane application.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source and from single manufacturer regularly engaged in supplying the product.

2.2 SELF-ADHERING SHEET WATERPROOFING

A. Rolled, Self-Adhering Sheet Waterproofing Membrane: Polymeric waterproofing membrane protected by release paper on polyethylene carrier film with exposed polymeric membrane strips on both sides.

B. Subject to compliance with requirements, provide one of the following products:
1. Basis for Design: MEL-ROL Waterproofing System by W.R. Meadows, Inc.
2. VM60 by American Hydrotech.
3. MiraDRI 860/861 by Carlisle Companies, Inc.
4. Bituthene 4000/3000 by GCP Applied Technologies.
5. Blueskin WP200 by Henry (Carlisle Companies, Inc.).
6. Colphene by Soprema

C. Waterproofing membrane shall have the following performance characteristics:
1. Compliance: AREMA Specification Chapter 29 - Waterproofing.
2. Thickness:
   a. Carrier Film: 4 mils.
   b. Polymeric Membrane: 56 mils.
3. Tensile Strength, ASTM D412, Die C:
   a. Carrier Film: 5900 psi (40.71 MPa), minimum.
   b. Polymeric Membrane: 460 psi (3.23 MPa), minimum.
4. Elongation, ASTM D412, Die C: Polymeric Membrane: 971 % minimum.
5. Peel Adhesion, ASTM D903: 11.8 lbf/in. (2068 N/m).
6. Lap Adhesion, ASTM D1876: 8.62 lbf/in. (1508 N/m).
7. Water Vapor Permeability, ASTM E96, Method B: 0.036 perms.
8. Water Absorption, ASTM D570: 0.1 percent, 72 hours maximum.
9. Resistance to Hydrostatic Head, ASTM D5385: Equivalent to 230.9 feet (70.3 m) of water.
10. Puncture Resistance, ASTM E154: 48.2 lbf (214.6 N).
11. Exposure to Fungi, Soil Test: Pass, 16 weeks.
12. Color:
    a. Carrier Film: White.
    b. Polymeric Membrane: Black.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Coordinate all auxiliary materials and accessories to be provided by selected waterproofing manufacturer (Basis for Design products listed below).
2. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Surface Conditioner:

1. MEL-PRIME Solvent-based adhesive, or approved equivalent.

2. MEL-PRIME W/B water-based adhesive, or approved equivalent.

C. Flashing and Fillets: MEL-ROL LIQUID MEMBRANE, or approved equivalent.

D. Termination Sealant: POINTING MASTIC.

E. Termination Bar: TERMINATION BAR.

F. Corner and Detailing Tape: DETAIL STRIP.

G. Waterproofing Protection Course: PC-2 PROTECTION COURSE or PERMINATOR 10-mil or 15-mil, or approved equivalent.

H. Rolled Matrix Drainage System: MEL-DRAIN Rolled Matrix Drainage System, or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.

C. Do not apply waterproofing to surfaces unacceptable to waterproofing manufacturer.

D. Concrete surfaces must be clean, smooth and free of standing water.

E. Patch all holes and voids and smooth out any surface misalignments.

F. Apply only enough adhesive to surfaces that will be covered with self-adhering membrane within one working day. Apply adhesive in accordance with manufacturer’s recommended coverage rates.

G. Inside and Outside Corners

1. Apply fillet beads of termination sealant at inside corners and allow to cure.
2. Apply a 9-inch (23 cm)-wide strip of self-adhering detailing membrane centered over inside and outside inside corners.

H. Joint Reinforcement
1. For static cracks and cold joints, apply a 9-inch (23 cm)-wide strip of self-adhering detailing membrane centered over the joint.

I. Pipe Penetrations
1. Finger flash pipe penetrations with a minimum 6-inch (15 cm) wide detailing tape by applying 3-inch (7.6 cm) fingers onto surrounding substrate and 3-inches (7.6 cm) of tape onto pipe circumference, with 2-inch (5 cm) minimum overlap. Seal all edges of flashing with termination sealant. Seal all terminations with termination sealant.

J. Seal all terminations and exposed membrane edges with termination sealant.

3.3 APPLICATION

A. Primary Membrane Application
1. Apply waterproofing membrane system in accordance with manufacturer's instructions.
2. When tying into ‘blindside’ waterproofing, overlap a minimum of 6 inches (15 cm).
3. Remove release backing paper, then position the membrane at the lowest point. Ensure the proper overlap is maintained for all side and end laps.
4. Pull balance of release paper off, then press into place to ensure full contact and elimination of all wrinkles. Roll press entire membrane and seams.
5. Stagger end laps and overlap all seams at least 2 ½ inches (6.35 cm). In vertical applications, material may be applied in vertical or horizontal orientation.
6. Terminate top leading edge of membrane with termination bar and termination sealant as required.
7. Seal all terminations and non-factory edges with termination sealant.
8. Inspect membrane before covering and repair as necessary. Cover tears and inadequate overlaps with membrane, extending 6 inches (15 cm) beyond affected areas. Seal all sides of patches and repair areas with termination sealant.

3.4 PROTECTION

A. Protect membrane immediately after application with the application of rigid insulation by others or polyolefin sheet.

B. Backfill immediately using care to avoid damaging waterproofing membrane system.

END OF SECTION 07 13 26

SECTION 07 14 16

COLD FLUID-APPLIED WATERPROOFING

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:

1. Polyurethane waterproofing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation specified in other Sections.
b. Minimum curing period.
c. Forecasted weather conditions.
d. Special details and sheet flashings.
e. Repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:

1. Show locations and extent of waterproofing.

2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
3. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).
3. Insulation, 8 by 8 inches (200 by 200 mm).
4. Drainage panel, 4 by 4 inches (100 by 100 mm).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft. (9.3 sq. m) in area
b. Description: Each type of wall installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.8 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials, protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M.

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 Seamless Membrane.
b. BASF Construction Chemicals, LLC, Building Systems; Sonoshield HLM 5000.

c. Carlisle Coatings & Waterproofing Inc; MiraSEAL.
d. CETCO; LDC 60.
e. Neogard; Neogard 7401.
f. Tremco Incorporated; TREMproof 250 GC.
g. United Coatings; Elastall 1000.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric,manufacturer's standard weight.

E. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

F. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.4 PROTECTION COURSE

A. Protection Course: Molded-polystyrene board insulation, ASTM C 578, Type I, 0.90-lb/cu. ft. (15-kg/cu. m) minimum density, 1-inch (25-mm) minimum thickness.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Molded-Sheet Drainage Panel: Comply with Section 334600 "Subdrainage."

B. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

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. American Hydrotech, Inc; Hydrodrain 400.
    b. Carlisle Coatings & Waterproofing; CCW MiraDRAIN 6200.
    c. Grace Construction Products; W.R. Grace & Co. -- Conn; Hydroduct 220.
    d. Insulation Solutions, Inc; AquaCheck DB 1500
    e. Liquid Plastics Inc; Deco-Drain 42.
    f. Urethane Polymers International, Inc; EZE-DRAIN V-2.

2.6 INSULATION

A. Insulation, General: Comply with Section 072100 "Thermal Insulation."

B. Board Insulation: Extruded-polystyrene board insulation according to ASTM C 578, square or shiplap edged.

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. DiversiFoam Products.
    b. Dow Chemical Company (The).
    c. Owens Corning.
    d. Pactiv Corporation.
    e. T. Clear Corporation.
2. Type VI, 40-psi (276-kPa) minimum compressive strength.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471 Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with ASTM C 1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply

waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm).
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

F. Install protection course with butted joints over waterproofing before starting subsequent construction operations.

1. For vertical applications, set protection course in nominally cured membrane, which will act as an adhesive. If membrane cures before application of protection course, use adhesive.

3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

1. For vertical applications, install protection course before installing drainage panels.

B. Molded-Sheet Collector-Panel System: Install according to manufacturer's written instructions. Connect to piped subdrainage system specified in Section 334600 "Subdrainage."

3.7 INSULATION INSTALLATION

A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:

1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) f installed waterproofing or part thereof.

B. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

C. Prepare test and inspection reports.

3.9 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation and insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 07 14 16

SECTION 07 18 00

TRAFFIC COATINGS

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 traffic coatings for the following applications:
   1. Equipment-room floor.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including installation instructions.

B. Shop Drawings: For traffic coatings.

   1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions.
   2. Include plans showing layout of 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 exposed finish.

D. Samples for Verification: For each type of exposed finish, prepared on rigid backing.

   1. Provide stepped Samples on backing to illustrate buildup of traffic coatings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of traffic coating.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup for each traffic coating and substrate to receive traffic coatings.
2. Size: 200 sq. ft. (18.5 sq. m) of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install traffic coating until items that penetrate membrane have been installed.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Adhesive or cohesive failures.
b. Abrasion or tearing failures.
c. Surface crazing or spalling.
d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Material Compatibility: Provide primers; base-, intermediate-, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Source Limitations:

1. Obtain traffic coatings from single source from single manufacturer.
2. Obtain primary traffic-coating materials, including primers, from traffic-coating manufacturer. Obtain accessory materials including aggregates, sheet flashings, joint sealants, and substrate repair materials of types and from sources recommended in writing by primary material manufacturer.
3. Obtain pavement-marking paint from single source from single manufacturer.

2.2 TRAFFIC COATING

A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, waterproofing membrane system with integral wearing surface for equipment-room floor; according to ASTM C 957.

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 Polymer Technology Corporation.
b. AVM Industries, Inc.
c. BASF Construction Chemicals, LLC - Building Systems.
d. Carlisle Coatings & Waterproofing Inc.
e. Crossfield Products Corp.
f. Euclid Chemical Company (The); an RPM company.
g. Gaco Western LLC.
h. Key Resin Company.

i. LymTal International Inc.
j. Neogard; Division of Jones-Blair.
k. Pacific Polymers International, Inc.
l. ParexLahabra, Inc.
m. Pecora Corporation.
n. POLY-CARB, Inc.
o. Sherwin-Williams Company (The).
p. Tremco Incorporated; an RPM company.
q. Urethane Polymers International, Inc.

B. Primer: Liquid primer recommended for substrate and conditions by traffic-coating manufacturer.

C. Preparatory and Base Coats: Polyurethane, Aromatic urethane, Aliphatic urethane, or epoxy.

1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated.

D. Intermediate Coat: Polyurethane, Aromatic urethane, Aliphatic urethane, or epoxy.

1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, measured excluding aggregate.
2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated.

E. Topcoat: Polyurethane, Aromatic urethane, Aliphatic urethane, Aromatic urethane with UV inhibitors, or epoxy.

1. Thicknesses: Minimum dry or wet film thickness as recommended in writing by manufacturer for substrate and service conditions indicated, measured excluding aggregate.
2. Aggregate Content: As recommended in writing by traffic-coating manufacturer for substrate and service conditions indicated
3. Color: As selected by Architect from manufacturer's full range

F. Aggregate: Manufacturer's standard aggregate for each use indicated of particle sizes, shape, and minimum hardness recommended in writing by traffic-coating manufacturer.

G. VOC Content: Traffic coating shall have a VOC content of 150 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Low-Emitting Materials: Traffic coating shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 ACCESSORY MATERIALS

A. Joint Sealants: ASTM C 920.

B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer

C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.

D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of traffic-coating work.

B. Verify that substrates are visibly dry and free of moisture.
   1. Test for moisture content by method recommended in writing by traffic-coating manufacturer

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.

D. Proceed with installation only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

   1. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
   2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. General: Before applying traffic coatings, clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

B. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

C. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

D. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to ASTM D 4259. Do not acid etch.

1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
2. Remove concrete fins, ridges, and other projections.
3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and other incompatible materials that might affect coating adhesion.
4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according to manufacturer's written recommendations.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 TRAFFIC-COATING APPLICATION

A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.

B. Apply number of coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.

C. Start traffic-coating application in presence of manufacturer's technical representative.

D. Verify that wet film thickness of each coat complies with requirements every 100 sq. ft. (9 sq. m)

E. Uniformly broadcast aggregate on coats specified to receive aggregate. Embed aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

G. Cure traffic coatings. Prevent contamination and damage during application and curing stages.

3.6 PAVEMENT MARKINGS

A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been verified with Architect and traffic coating has cured.

B. Sweep and clean surface to eliminate loose material and dust.

C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with uniform straight edges. Apply at manufacturer's recommended rates for a 15-mil- (0.4-mm-) minimum, wet film thickness.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to 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 pavement-marking paint at a rate of 6 lb/gal. (0.72 kg/L).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform the following field tests and inspections:

1. Materials Testing:

a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of Contractor.
b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.

c. Testing agency shall verify thickness of coatings during traffic-coating application for each 600 sq. ft. (56 sq. m) of installed traffic coating or part thereof.

2. If test results show traffic coating does not comply with requirements, remove and replace or repair the membrane as recommended in writing by traffic-coating manufacturer and make further repairs after retesting until traffic-coating installation passes.

B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.8 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 18 00

SECTION 07 2 100

THERMAL INSULATION

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:

1. Foam-plastic board insulation.
2. Spray polyurethane foam insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES

1.5 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

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. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.
   d. Pactiv Building Products.

2. Type X, 15 psi (104 kPa).
3. Type IV, 25 psi (173 kPa).
4. Type VI, 40 psi (276 kPa).
5. Type VII, 60 psi (414 kPa).
6. Type V, 100 psi (690 kPa).

2.2 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

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. BASF Corporation.
   b. BaySystems NorthAmerica, LLC.
   c. Dow Chemical Company (The).

d. ERSystems, Inc.
e. Gaco Western Inc.
f. Henry Company.
g. NCFI; Division of Barnhardt Mfg. Co.
h. SWD Urethane Company.
i. Volatile Free, Inc.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

2.3 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

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. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

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. AGM Industries, Inc.; [RC150] [SC150].
b. Gemco; [Dome-Cap] [R-150] [S-150].

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

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. AGM Industries, Inc.; TACTOO Adhesive.
b. Gemco; Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units according to manufacturer's written instructions.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.5 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.7 INSULATION SCHEDULE

A. Insulation Type : Type IV extruded-polystyrene board insulation.

B. Insulation Type : Type VI extruded-polystyrene drainage panels.

C. Insulation Type : Type VII Polyurethane spray foam insulation.

END OF SECTION 07 21 00

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

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 fluid-applied, vapor-permeable membrane air barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
    c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.

1. Qualitative Air-Leakage Testing: Mockups will be tested for evidence of air leakage according to ASTM E 1186, chamber depressurization with detection liquids.
2. Quantitative Air-Leakage Testing: Mockups will be tested for air leakage according to ASTM E 783.
3. Adhesion Testing: Mockups will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. (207 kPa) according to ASTM D 4541.
4. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

B. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and complying with VOC content limits of authorities having jurisdiction.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 283.

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

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. Elastomeric, Modified Bituminous Membrane:

1) Henry Company; Air-Bloc 07.
2) Hohmann & Barnard, Inc.; Textroflash Liquid VP.
3) Meadows, W. R., Inc.; Air-Shield LMP.
4) Tremco Incorporated, an RPM company; ExoAir 220R.

b. Synthetic Polymer Membrane:

1) Carlisle Coatings & Waterproofing Inc.; Barritech VP.
2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.
3) Henry Company; Air-Bloc 31 or Air-Bloc 33.
4) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight VP.
5) Tremco Incorporated, an RPM company; ExoAir 230.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Vapor Permeance: Minimum 10 perms (580 ng/Pa x s x sq. m); ASTM E 96/E 96M.
c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor retarding, 30 to 40 mils (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Modified Bituminous Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

F. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch (0.64 mm) thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

L. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- (0.43-mm-) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance value of 37 perms (2145 ng/Pa x s x sq. m).

M. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with galvanized-steel termination bars and fasteners.

N. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-

component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

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. Dow Corning Corporation; 123 Silicone Seal.
    b. Momentive Performance Materials Inc.; US11000 UltraSpan.
    c. Pecora Corporation; Sil-Span.
    d. Tremco Incorporated, an RPM company; Spectrem Simple Seal.

O. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

P. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers,

exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply preformed silicone-sealant extrusion so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.
   1. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, counterflashing strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

   1. Apply primer to substrates at required rate and allow it to dry.
   2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
   3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.

C. Apply strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air-barrier system has been provided.
   3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   4. Site conditions for application temperature and dryness of substrates have been maintained.
   5. Maximum exposure time of materials to UV deterioration has not been exceeded.
   6. Surfaces have been primed, if applicable.
   7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   8. Termination mastic has been applied on cut edges.
   9. Strips and transition strips have been firmly adhered to substrate.
   10. Compatible materials have been used.
   11. Transitions at changes in direction and structural support at gaps have been provided.
   12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   13. All penetrations have been sealed.

B. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than [30] [60] <Insert number> days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 26

SECTION 07 41 13.16

STAND SEAM METAL ROOF PANELS

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 standing-seam metal roof panels.

PREINSTALLATION MEETINGS

B. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 12 feet (3.5 m) square by full thickness, including attachments and accessories.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 1680 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

D. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.

E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.

B. Vertical-Rib, Snap-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and snapping panels together.

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 Architectural Products.
b. AEP Span; a BlueScope Steel company.
c. Architectural Building Components.
d. Architectural Metal Systems; a Nucor company.
e. CENTRIA Architectural Systems.
f. Dimensional Metals, Inc.
g. Englert, Inc.
h. Fabral.
i. Garland Company, Inc. (The)
j. IMETCO.
k. MBCI; a division of NCI Building Systems, L.P.
l. McElroy Metal, Inc.
m. Merchant & Evans.
n. Metal-Fab Manufacturing, LLC.
o. Metal Sales Manufacturing Corporation.
p. Morin; a Kingspan Group company.
q. Petersen Aluminum Corporation.
r. Ryerson, Inc.
s. Ultra Seam, Inc.
t. Union Corrugating Company.
u. VICWEST.

2. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.040 inch (1.02 mm).
b. Surface: Smooth, flat finish.
c. Exterior Finish: Three-coat fluoropolymer.
d. Color: As selected by Architect from manufacturer's full range

3. Clips: Two-piece floating to accommodate thermal movement.

a. Material: 0.028-inch- (0.71-mm-) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

4. Panel Coverage: 16 inches (610 mm)
5. Panel Height: 1.75 inches (44 mm)

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
    b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT
    c. Henry Company; Blueskin PE200 HT.
    d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
    e. Metal-Fab Manufacturing, LLC; MetShield.
    f. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- (2400-mm-)

long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match roof fascia and rake trim.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot- (3-m-) long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Roof Curbs: Fabricated from same material as roof panels,; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch- (1.52-mm-) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch- (25-mm-) thick, rigid insulation.

G. Panel Fasteners: Self-tapping screws designed to withstand design loads.

H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:
1. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated below , wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Extend underlayment into gutter trough. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Copper Panels: Use copper, stainless-steel, or hardware-bronze fasteners.
4. Stainless-Steel Panels: Use stainless-steel fasteners.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Clipless Metal Panel Installation: Fasten metal panels to supports with screw fasteners at each lapped joint at location and spacing recommended by manufacturer.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

I. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

J. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

K. Roof Curbs: Install flashing around bases where they meet metal roof panels.

L. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13.16

SECTION 07 42 13

METAL WALL PANELS

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:
   1. Concealed-fastener, lap-seam metal wall panels.
   2. Metal soffit panels.

B. Related Sections:
   1. Section 072700 "Air Barriers" for continuous air barrier systems.
   2. Section 076200 "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.3 DEFINITION

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) of wall area when tested according to ASTM E 283 at the following test-pressure difference:

   1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. (300 Pa) and not more than 12 lbf/sq. ft. (575 Pa).

1. Water Leakage: As defined according to AAMA 501.1.

F. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

1. Wind Loads: Determine loads based on the following minimum design wind pressures:
   a. Uniform pressure as indicated on Drawings.

2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): [120 deg F (67 deg C), ambient; 180 deg F (100 deg C)], material surfaces.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

   a. Flashing and trim.

b. Anchorage systems.

C. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Wall and Soffit Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
2. Trim and Closures: 12 inches (305 mm) long. Include fasteners and other exposed accessories.
3. Accessories: 12-inch- (305-mm-) long Samples for each type of accessory.

E. Delegated-Design Submittal: For metal wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items. Show the following:

1. Wall panels and attachments.
2. Girts.
3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Field quality-control reports.

D. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal wall panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.

D. Fire-Resistance Ratings: Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical corner panel, including soffit, as shown on Drawings; approximately one bay wide by one story high by full thickness, including insulation, supports, attachments, and accessories.
2. Conduct water spray test of mockup of metal wall panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.

6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal wall panel installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.11 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.
2. Exposed Coil-Coated Finish:
a. 3-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear

topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 FIELD-INSTALLED THERMAL INSULATION

A. Refer to Section 072100 "Thermal Insulation."

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60-lb/cu. ft. (26-kg/cu. m), with maximum flame-spread index of 75 and smoke-developed index of 450.

2.3 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G60 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Subgirts: Manufacturer's standard C- or Z-shaped sections, 0.064-inch (1.63-mm) nominal thickness.

C. Zee Clips: 0.079-inch (2.01-mm) nominal thickness.

D. Base or Sill Angles: 0.079-inch (2.01-mm) nominal thickness.

E. Hat-Shaped, Rigid Furring Channels:

1. Nominal Thickness: As required to meet performance requirements
2. Depth: 7/8 inch (22 mm).

F. Cold-Rolled Furring Channels: Minimum 1/2-inch- (13-mm-) wide flange.

1. Nominal Thickness: As required to meet performance requirements

2. Depth: 3/4 inch (19 mm)
3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with 0.040-inch (1.02-mm)nominal thickness.
4. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.57-mm-) diameter wire, or double strand of 0.048-inch- (1.22-mm-) diameter wire.

G. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), and depth required to fit insulation thickness indicated.

1. Nominal Thickness: As required to meet performance requirements

H. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.4 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.5 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners[and factory-applied sealant] in side laps. Include accessories required for weathertight installation.

B. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and flat pan between panel edges; with narrow reveal joint between panels.

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. ATAS International, Inc.
b. CENTRIA Architectural Systems.
c. Metal Sales Manufacturing Corporation.
d. Metecno-Morin.
e. Petersen Aluminum Corporation.

2. Material: Aluminum sheet, 0.040 inch (1.02 mm) thick.

a. Exterior Finish: 3-coat fluoropolymer
b. Color: As selected by Architect from manufacturer's full range

3. Panel Coverage: 12 inches (305 mm)
4. Panel Height: 1.0 inch (25 mm)

2.6 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.018-inch (0.46-mm) minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.7 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

1. Soffit Framing: Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 THERMAL INSULATION INSTALLATION

A. Board Insulation: Extend insulation in thickness indicated to cover entire wall. Comply with installation requirements in Section 072100 "Thermal Insulation."

1. Erect insulation horizontally and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.. Attach furring members to substrate with screws spaced 24 inches (610 mm) o.c.
2. Retain insulation in place by metal clips and straps or integral pockets within panels, spaced at intervals according to insulation manufacturer's instructions.

Maintain cavity width between insulation and metal liner panel of dimension indicated.

3.4 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence metal wall panel installation and install minimum of 300 sq. ft. (27.8 sq. m.) in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
4. Install screw fasteners in predrilled holes.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal wall panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.
2. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized steel fasteners for surfaces exposed to the interior.
3. Copper Wall Panels: Use copper, stainless-steel or hardware-bronze fasteners.
4. Stainless-Steel Wall Panels: Use stainless-steel fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of

gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
7. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

F. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

3.5 METAL SOFFIT PANEL INSTALLATION

A. In addition to complying with requirements of "Metal Wall Panel Installation, General" Article, install metal soffit panels to comply with the requirements of this article.

B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft. (300 Pa).

C. Water-Spray Test: After completing the installation of 75-foot- (23-m-) by-2-story minimum area of metal wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test completed metal wall panel installation, including accessories.

E. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13

SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN(TPO) ROOFING

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:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Roof insulation.

B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 061000 "Rough Carpentry"for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's

representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.
2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Carlisle SynTec Incorporated.
2. Cooley Engineered Membranes.
3. Custom Seal Roofing.
4. Firestone Building Products.
5. Flex Roofing Systems.
6. GAF Materials Corporation.
7. GenFlex Roofing Systems.
8. Johns Manville.
9. Mule-Hide Products Co., Inc.
10. Versico Incorporated.

B. Source Limitations: Obtain components including roof insulation, fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
1. As indicated on drawings

D. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

E. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance index of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible TPO sheet.

1. Thickness: 60 mils (1.5 mm), nominal.
2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.
j. Other Adhesives and Sealants: 250 g/L.

3. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services')

"Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, 5/8 inch (16 mm) thick.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. (26-kg/cu. m) minimum density, square edged.

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. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.
d. Pactiv Corporation.

2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
   1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

   1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

I. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
2. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
4. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and fasten to roof deck.
1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

K. Install slip sheet over insulation and immediately beneath roofing.

3.6 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.7 MECHANICALLY FASTENED ROOFING INSTALLATION

A. Mechanically fasten roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. For in-splice attachment, install roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply roofing with side laps shingled with slope of roof deck where possible.

F. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: .
2. Address:.
3. Building Name/Type:
4. Address:
5. Area of Work:
6. Acceptance Date: _____.
7. Warranty Period:
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding ;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled

surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 54 23

SECTION 07 72 00

ROOF ACCESSORIES

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:

1. Roof curbs.
2. Roof hatches.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 055213 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

1. e coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Mill Finish: As manufactured.

C. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

D. Copper Sheet: ASTM B 370, manufacturer's standard temper.

E. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

F. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

G. Steel Tube: ASTM A 500, round tube.

H. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

I. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.3 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

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. AES Industries, Inc.
   b. Curbs Plus, Inc.
   c. Custom Solution Roof and Metal Products.
   d. Greenheck Fan Corporation.
   e. LM Curbs.
   f. Metallic Products Corp.
   g. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   h. Pate Company (The).
   i. Roof Products, Inc.
   j. Safe Air of Illinois.
   k. Thybar Corporation.
   l. Vent Products Co., Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

1. Finish: Baked enamel or powder coat.
2. Color: As selected by Architect from manufacturer's full range

D. Construction:

1. Insulation: Factory insulated with board insulation.
2. Liner: Same material as curb, of manufacturer's standard thickness and finish.
3. Factory-installed wood nailer at top of curb, continuous around curb perimeter.
4. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
6. Top Surface: Level around perimeter with roof slope accommodated by sloping the deck-mounting flange.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

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. AES Industries, Inc.
b. Babcock-Davis.
c. Bilco Company (The).
d. Bristolite Skylights.
e. Custom Solution Roof and Metal Products.
f. Dur-Red Products.
g. Hi Pro International, Inc.
h. J. L. Industries, Inc.
i. Metallic Products Corp.
j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
k. Naturalite Skylight Systems; Vistawall Group (The).
l. Nystrom.
m. O'Keeffe's Inc.
n. Pate Company (The).
o. Precision Ladders, LLC.

B. Type and Size: Single-leaf lid, 30 by 36 inches (750 by 900 mm).

C. Type and Size: Double-leaf lid, 76 by 76 inches (1830 by 2440 mm).

D. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

E. Hatch Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

F. Construction:

1. Insulation: Glass-fiberboard.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Hatch Lid: Glazed, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
4. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
5. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
6. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.
7. Sloping Roofs: fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

G. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).
2. Provide remote-control operation.

H. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches (1060 mm) above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm)in diameter.
5. Chain Passway Barrier: Galvanized proof coil chain with quick link on fixed end.

6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
9. Fabricate joints exposed to weather to be watertight.
10. Fasteners: Manufacturer's standard, finished to match railing system.
11. Finish: Manufacturer's standard.

    a. Color: As selected by Architect from manufacturer's full range.

I. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches (1060 mm) above finished roof deck.
3. Material: Aluminum.
4. Post: 1-5/8-inch- (41-mm-) diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.

    a. Color: As selected by Architect from manufacturer's full range

J. Motor:
1. Provide Manufacturer’s standard motor operation and control for remote opening of roof hatch.

2.5 ENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.
3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof-hatch curb.
4. Attach ladder-assist post according to manufacturer's written instructions.

F. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related work specified elsewhere:

1. Window framing internal sealants.
2. Glazing sealants.
3. Roofing and flashing sealants.
4. Firestopping.

B. Definitions:

1. Joint sealant:

   a. A weatherproof elastomer used in filling and sealing joints, having properties of adhesion, cohesion, extensibility under tension, compressibility and recovery; designed to make joints air and watertight.
   b. Material is designed generally for application in exterior joints and for joints subject to movement.

2. Joint sealant compound:

   a. A material used in filling joints and seams, having properties of adhesion and cohesion; not required to have extensibility and recovery properties.
   b. Material is designed generally for application in interior joints not subject to movement.

3. Caulk: The process of filling joints, without regard to type of material.
4. Joint failure: A caulked joint exhibiting one or more of the following characteristics:

   a. Air and/or water leakage.
   b. Migration and/or reversion.
   c. Loss of adhesion.
   d. Loss of cohesion.
   e. Failure to cure.

f. Discoloration.
g. Staining of adjacent work.
h. Development of bubbles, air pockets or voids.

1.2 SUBMITTALS:

A. Product data: Submit manufacturer's product description, indicating conformance with specified requirements and installation instructions for each type of sealant. Indicate preparation and priming requirements for each substrate condition.

B. Color samples:

1. Samples for initial selection: Samples shall be actual materials or literature depicting actual colors of standard color materials showing full range of colors available for each product exposed to view.
2. Samples for verification: For each kind and color of joint sealant required, provide samples with joint sealants in 1/2" wide joints formed between two 6" long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

C. Adhesion compatibility test results: Submit a letter from sealant manufacturer indicating adhesion and compatibility testing has been performed and that materials are compatible and that adhesion is acceptable. Indicate requirements for primers or special preparation.

D. Joint sealant schedule: Include the following information:

1. Joint sealant applications, joint locations, and designations.
2. Joint sealant manufacturers and product names.
3. Joint sealant formulations.
4. Joint sealant colors.

1.3 QUALITY ASSURANCE:

A. Applicable standards as referenced herein:

1. ASTM International (ASTM).

B. Adhesion compatibility tests: Perform tests on actual samples of aluminum framing system, synthetic stucco, and cast stone components, to determine that materials are compatible and that adhesion is acceptable. Identify requirements for primers or special preparation.

1. Test structural sealants in accord with ASTM C1135-00(2011).
2. Test sealants used in conjunction with synthetic stucco in accord with ASTM C1382-11.

C. Architect reserves the right to reject work not in conformance with selected colors, based upon verification samples.

D. Mock-up:

1. Prepare, caulk and finish one mock-up sample of each joint condition.
2. Sample joints shall be approved by Architect prior to beginning work. Approved, undamaged mock-up joints shall serve as a standard of quality for the remainder of the work.

1.4 PROJECT/SITE CONDITIONS:

A. Weather conditions:

1. Install no materials under adverse weather conditions or when temperatures are below or above those recommended by manufacturer's product data or when substrate moisture content is above manufacturer's recommended level.
2. Proceed with work only when forecasted weather conditions are favorable for joint cure and development of high early bond strength.
3. Wherever joint width is affected by ambient temperature variations, install materials only when temperatures are in lower third of manufacturer's recommended installation temperature range.

B. Protection of adjacent surfaces:

1. Protect by applying masking material or manipulating application equipment to keep materials in joint. If masking materials are used, allow no tape to touch cleaned surfaces to receive sealant. Remove tape immediately after sealant application, before surface skin begins to form.
2. Remove misapplied materials from surfaces by using solvents and methods recommended by manufacturer.
3. At surfaces from which materials have been removed, restore to original condition and appearance.

1.5 WARRANTIES:

A. Installer's warranty: Warrant work to be watertight and free from defects in materials and workmanship, including joint failure, for a period of five years. Form of warranty shall be as included in Division 00.

B. Exterior silicone sealant material warranty: Warrant exterior silicone sealants to be free from defects in materials and to provide structural adhesion, watertight weather seal and non-staining of adjacent materials for a period of twenty years.

C. Warranties shall begin at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL:

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. All wall panel joints on exterior and interior shall have backer rod and caulk with an elastomeric sealant.

C. Exterior Tilt-Up Concrete wall panel joints shall be silicone, equal to Sikaflex-2c NS, applied after Tilt-Up Concrete panels have been coated. Install backer rod half way into joint prior to coating panels; remove backer rod and rotate 180 degrees and reinsert prior to installing sealant.

D. Interior Tilt-Up Concrete wall panel joints shall be polyurethane, equal to Sonneborn Sonolastic SL-2, a multi-component, self-leveling, elastomeric polyurethane sealant that is mixed and poured in place. It must be installed prior to painting walls; sealant is required behind applied wall insulation.

E. Provide sealant at interior joint where wall panels abut slab on grade. Provide sealant at all interior slab on grade penetrations and exterior wall penetrations.

F. VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.

3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

G. Provide sealant at all exterior concrete walks and paving, where paving abuts a vertical surface, and at concrete and asphalt joints. Material shall be a permanent non-water soluble , flexible, exterior use sealant, impervious to effects of ultraviolet light and petroleum products.

H. All joints in the sort floor shall be filled with semi-rigid epoxy joint filler equalt to Metzger McGuire MM-80, full depth. Provide backer rod at all construction joints. Backer rod at control joints is not required. Delay filling as long as possible. Utilize stain preventing film (SPF) at all joints. Construction joints shall be re-sawn prior to joint fill operation.

I. All floor expansion joints shall be CS Group SGP-600, Gasket Color #136 Gray.

J. Exterior Wall Expansion Joints shall be CS Group AFWC-200X, Finish:Anodized to match.

K. Interior Wall Expansion Joint shall be CS Group AFW-600, Finish: Clear Anodized

L. Aluminum in contact with concrete/ masonry shall have a 2 mil heavy metal free high solids primer.

2.2 SILICONE SEALANTS:

A. Low modulus silicone sealant:

1. Acceptable products; subject to compliance with specified requirements:

a. Dow Corning Corp., #790 or as approved by the Architect.

2. Type: One-part, low modulus silicone rubber; meeting ASTM C920-14a, Type S, Grade NS, Class 50, for use NT.
3. Colors: Standard colors as selected by the Architect.

B. Medium modulus silicone sealant:

1. Acceptable products; subject to compliance with specified requirements:

a. Dow Corning Corp., #795 or as approved by the Architect.

2. Type: One-part silicone rubber; meeting ASTM C920-14a, Type S, Grade NS, Class 50, for use NT.
3. Colors: Standard colors as selected by the Architect.

2.3 TWO-PART POLYURETHANE SEALANT FOR HORIZONTAL TRAFFIC-BEARING PAVEMENTS:

A. Acceptable products:

1. BASF Building Systems, MasterSeal SL 2.
2. Pecora Corp., Urexpan NR-200.
3. Tremco, Inc., an RPM Company, 45 SSL.

B. Characteristics:

1. Type: Two-component polyurethane sealant for horizontal traffic-bearing surfaces meeting ASTM C920-14a, Type M, Grade P or NS, minimum Class 25, for use T; self-leveling for flat surfaces and non-sag for sloped surfaces.
2. Colors: Standard colors as selected by Architect.

2.4 SILICONE BATH SEALANT FOR WET AREAS:

A. Acceptable products:

1. Dow Corning Corp., 786 Mildew-Resistant Silicone Sealant or as approved by the Architect.

B. Characteristics:

1. Type: One-part silicone rubber, mildew- and stain-resistant, acid-curing silicone sealant; meeting ASTM C920-14a, Type S, Grade NS, Class 25, for use NT.
2. Color: Clear, white or off-white, as selected by the Architect.

2.5 SOLVENT-RELEASE-CURING ACRYLIC SEALANT:

A. Acceptable products:

1. Franklin International, Titebond Painters Plus Caulk.
2. Schnee-Morehead, Inc., Acryl-R Acrylic Sealant.
3. Tremco, Inc., an RPM Company, Mono 555.

B. Characteristics:

1. Type: One-part, acrylic polymer sealant, meeting ASTM C1311-14.
2. Colors: Standard colors as selected by Architect.

2.6 PAINTABLE ACRYLIC-LATEX JOINT SEALANT:

A. Acceptable products:

1. Bostik, Chem-Calk 600.
2. Franklin International, Titebond Painters Caulk.
3. Momentive Performance Materials, Inc., GE RCS20.
4. Pecora Corp., AC-20 Acrylic Latex.
5. Tremco, Inc., an RPM Company, Tremflex 834.

B. Characteristics: Flexible, paintable, non-staining, non-bleeding acrylic latex or siliconized acrylic emulsion, meeting ASTM C834-14, Type OP, Grade NF.

2.7 ACCESSORY MATERIALS:

A. Joint cleaner: Type recommended by material manufacturer for substrates indicated.

B. Joint primer/sealer: Type recommended by material manufacturer for substrates, conditions and exposures indicated.

C. Bond breaker tape: Plastic tape applied to contact surfaces where bond to substrate or joint filler must be avoided for material performance.

D. Sealant backer rod: Compressible rod stock as recommended by sealant manufacturer for compatibility with sealant. Provide size and shape of rod to control joint depth.

E. Tooling agent: Agent recommended by material manufacturer to ensure contact of material with inner joint faces.

PART 3 - EXECUTION

3.1 JOINT SURFACE PREPARATION:

A. Clean joints of debris and projections including shims.

B. Clean joint surfaces immediately before caulking joints. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond.

C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless material manufacturer's product data indicates that alkalinity does not interfere with bond and performance. Etch with 5% solution of muriatic acid; neutralize with dilute ammonia solution; rinse with clean water and allow to dry before caulking.

D. Roughen joint surfaces of non-porous materials, unless material manufacturer's product data indicates equal bond strength as porous surfaces. Rub with fine abrasive cloth or wool to produce dull sheen.

3.2 APPLICATION:

A. Comply with joint sealant material manufacturer's product data and ASTM C1193-13 except where more stringent requirements are specified.

B. Prime joint surfaces where recommended by material manufacturer. Do not allow primer/sealer to spill or migrate onto adjacent surfaces.

C. Install backer rod for joint sealant materials, except where recommended by material manufacturer to be omitted for application indicated.

1. Place backer rod to maintain recommended sealant thickness and profile.
2. Place rod at depth to provide sealant manufacturer’s recommended sealant depth.
3. Do not twist rod during installation.
4. Place rod to minimize possibility of extrusion when joint is compressed.
5. Install bond breaker tape in lieu of backer rod for shallow, closed joints and as recommended by manufacturer’s product data.

D. Employ installation techniques which will ensure that materials are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and debris.

E. Do not allow materials to overflow onto adjacent surfaces. Prevent staining of adjacent surfaces.

F. Remove excess and misplaced materials as work progresses. Clean the adjoining surfaces to remove misplaced materials, without damage to adjacent surfaces or finishes.

G. Interior joints: At interior joints and seams at abutting and adjacent materials, recess joint sealant 3/16" in joints wider than 1/4". At joints 1/4" or less in width, tool joint sealant flush.

H. Tool joints of non-sag sealant to concave profile and smooth, uniform surface, flush with edges of substrate. Maintain sealant depth-to-width ratio in accord with manufacturer's product data.

I. Cure joint sealants and joint sealant compounds in accord with manufacturer's product data to obtain high early bond strength, internal cohesive strength and surface durability. Protect uncured surfaces from contamination and physical damage.

3.3 JOINT SEALANT SCHEDULE:

A. Exterior vertical expansion joints: Low modulus silicone sealant.

B. Exterior and interior joints in masonry, including control joints: Low modulus silicone sealant.

C. Exterior and interior joints at perimeter of aluminum framing systems: Medium modulus silicone sealant.

D. Exterior and interior joints at perimeter of hollow metal framing: Medium modulus silicone sealant.

E. Exterior joints between wall finish and conduit and pipe penetrations, base plates of light fixtures, signage supports, and other items applied to exterior wall surface: Medium modulus silicone sealant.

F. Interior concealed bedding joints and thresholds: Acrylic sealant. Solventrelease- curing acrylic sealant.

G. Exterior and interior horizontal traffic-bearing joints, excluding tile floor joints: Two-part polyurethane sealant.

H. Tile expansion and control joint sealant: Refer to Tiling section.

I. Firestopped joints: Firestop sealant as specified in Firestopping section.

J. Typical interior joints and seams at abutting and adjacent materials except as specified herein: Paintable acrylic-latex joint sealant.

K. Interior joints in conjunction with vanities, fixtures and tile finishes: Silicone bath sealant.

END OF SECTION 07 92 00

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door

hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
b. Complete (risers, point-to-point) access control system block wiring diagrams.
c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that

indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.

b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

a. McKinney (MK) - TA/T4A Series, 5-knuckle.

2.3 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

a. Rockwood (RO).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

C. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).

D. Construction Keying: Provide construction master keyed cylinders.

E. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. ASSA ABLOY ACCENTRA (YA) - 8800FL Series.
b. Corbin Russwin Hardware (RU) - ML2000 Series.
c. Sargent Manufacturing (SA) - 8200 Series.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise

indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.

C. Security Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed rim panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be constructed of high grade, heat treated, corrosion resistant nickel steel alloy, and have a full 3/4" throw projection with slide action positive deadlocking.

1. Static Load Force Resistance: Minimum 3000 lbs. certified independent tested.

2. Manufacturers:

a. ASSA ABLOY ACCENTRA (YA) - 7050 Series.
b. Corbin Russwin Hardware (RU) - ED4000S / ED5000S Series.

2.8 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible

to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Large body cast iron surface mounted door closers shall have a 30-year warranty.
2. Manufacturers:

    a. Corbin Russwin Hardware (RU) - DC8000 Series.
    b. Norton Rixson (NO) - 9500 Series.
    c. Sargent Manufacturing (SA) - 281 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.
4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
6. Manufacturers:

    a. Rockwood (RO).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Rockwood (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Norton Rixson (RF).
    b. Rockwood (RO).
    c. Sargent Manufacturing (SA).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Pemko (PE).

2.12 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Securitron (SU) - DPS Series.

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. RU - Corbin Russwin
3. RO - Rockwood
4. RF - Rixson
5. PE - Pemko
6. SU - Securitron

Hardware Sets

Set: 1.0
Doors: 1, 1P, 3, 4P, 5P
Description: EXT - PANIC

3	Hinge (heavy weight)	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK
1	Rim Exit Device, Nightlatch	ED5200S K157ET CLS7	630	RU
1	Door Pull	BF158	US32D	RO
1	Surface Closer	DC8210 A4 M54	689	RU
1	Armor Plate	K1050 36" X 1.5" LDW CSK TEK BEV	US32D	RO
1	Door Stop	467	Black	RO
1	Gasketing	303AS TKSP		PE
1	Sweep	315CN TKSP		PE
1	Threshold	2005AV MSES25SS		PE
1	Position Switch	DPS-M/W-WH (as required)		SU

Set: 2.0
Doors: 10P
Description: ELECT

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Rim Exit Device, Nightlatch	ED5200 P957ET	630	RU
1	Surface Closer	DC8210 A4 M54	689	RU
1	Armor Plate	K1050 36" X 1.5" LDW CSK TEK BEV	US32D	RO
1	Door Stop	409 / 446 [as required]	US32D	RO
3	Silencer	608		RO

Set: 3.0
Doors: 9P
Description: STOR - OHS

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Storeroom Lock	ML2057 PSA	630	RU
1	Surf Overhead Stop	10-336 Torx	630	RF
1	Armor Plate	K1050 36" X 1.5" LDW CSK TEK BEV	US32D	RO
3	Silencer	608		RO

Set: 4.0
Doors: 8P
Description: TOILET - OHS

3	Hinge (heavy weight)	T4A3786 4-1/2" x 4-1/2"	US26D	MK
1	Privacy Lock	ML2030 PSA V21	630	RU
1	Surface Closer	DC8210 A4 M54	689	RU
1	Mop Plate	K1050 4" X 1" LDW CSK TEK BEV	US32D	RO
1	Armor Plate	K1050 36" X 1.5" LDW CSK TEK BEV	US32D	RO
1	Door Stop	409 / 446 [as required]	US32D	RO
1	Gasketing	S773D		PE

Set: 5.0
Doors: 2, 2P, 3P, 4, 7P
Description: OH

1	Hardware	By door mfg

END OF SECTION 08 71 00

SECTION 08 33 23

OVERHEAD COILING DOORS

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:
   1. Insulated service doors

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
   3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
   6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E 330
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

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. ACME Rolling Doors.
b. Alpine Overhead Doors, Inc.
c. Alumatec Pacific Products.
d. Amarr Garage Doors.
e. ASTA Door Corporation.
f. C.H.I. Overhead Doors.
g. City-Gates.
h. Clopay Building Products.
i. Cookson Company.
j. Cornell Iron Works, Inc.
k. Janus International Corporation.
l. Lawrence Roll-Up Doors, Inc.
m. McKeon Rolling Steel Door Company, Inc.
n. Metro Door.
o. Overhead Door Corporation.
p. QMI Security Solutions.
q. Raynor.
r. Southwestern Rolling Steel Door Co.
s. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.

D. STC Rating: 21

E. Curtain R-Value: 10.9 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

F. Door Curtain Material: Galvanized steel.

G. Door Curtain Slats: Flat profile slats of 2-5/8-inch (67-mm) center-to-center height.
1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel, stainless steel, or aluminum extrusions and finished black powder coated with vinyl weatherseal.

I. Curtain Jamb Guides: Galvanized steelwith exposed finish matching curtain slats.

J. Hood: Match curtain material and finish.

1. Shape: Square.
2. Mounting: Face of wall

K. Locking Devices: Equip door with locking device assembly and chain lock keeper.

L. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day
2. Operator Location: Top of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.44 m) or lower.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic photoelectric sensor.

7. Control Station(s): Interior mounted

M. Curtain Accessories: Equip door with weatherseals.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch (0.25 mm).

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Stainless Steel: 0.025-inch- (0.64-mm-) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
3. Aluminum: 0.040-inch- (1.02-mm-) thick aluminum sheet complying with ASTM B 209 (ASTM B 209M), of alloy and temper recommended by manufacturer and finisher for type of use and finish indicated.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

D. Poll Hooks: Provide pole hooks and poles for doors more than 84 inches (2130 mm) high.

2.9 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

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. Chamberlain Group, Inc. (The).

2. Comply with NFPA 70.
3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

a. Phase: Polyphase.
b. Volts: 208V.
c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 08 33 23

SECTION 08 71 00

FINISH DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to the Drawings for Hardware Schedule and Hardware Sets.

B. All door hardware shall be fully accessible per the provisions of IBC 1010.1.9 and ANSI A117.1.

C. All door hardware shall meet the requirements for fire egress per the Authorities Having Jurisdiction (AHJ) and IBC requirements.

1.2 PROCUREMENT

A. Vendors
1. Items covered in this section shall be provided and installed by the General Contractor, unless noted otherwise on the drawings.
2. All items in this section shall be purchased by the general contractor.

1.3 SUMMARY

A. This Section includes commercial door hardware for the following:
1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 – Installation of Smoke Door Assemblies
7. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke

Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:
1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.4 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets included in the Drawings. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.
4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following, if requested:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.

c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.5 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware.

D. Automatic Operator Supplier Qualifications: Power operator products and accessories are required to be supplied and installed through current members of the manufacturer's "Power Operator Preferred Installer" program. Suppliers are to be factory trained, certified, and a direct purchaser of the specified power operators and be responsible for the installation and maintenance of the units and accessories indicated for the Project.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third-party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access-controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General Contractor to inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.

1.7 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

D. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

1.8 WARRANTY

A. General Warranty: Special warranties specified in this Section shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Special Warranty Periods:
1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Five years for exit hardware.
3. Twenty-five years for manual surface door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware.

1.9 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.10 DEFINITIONS

A. The following is a general list of terms included in the specification that may require additional definitions.

1. "RX" – Request to Exit
2. "EPT" – Electronic Power Transfer
3. "DPS" – Door Position Switch
4. "SFIC" – Small Format Interchangeable Core
5. "ELR" – Electric Latch Retraction
6. "NL" – Nigh Latch
7. "ELEC" – Electrified
8. "CLSRM" – Classroom

9. "LDW" – Less Door Width

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets shown on the Drawings and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets on the Drawings.

C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches (1.52m).
b. Three Hinges: For doors with heights 61 to 90 inches (1.55 to2.29m).
c. Four Hinges: For doors with heights 91 to 120 inches (2.31 to3.05m).
d. For doors with heights more than 120 inches (3.05m), provide 4 hinges, plus 1 hinge for every 30 inches (0.76m) of door height greater than 120 inches (3.05m).

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3 feet 0 inches (0.91m): 4-1/2/-inch (114.3mm) standard or heavy weight as specified.
b. Sizes from 3 feet 1 inch to 4 feet 0 inches (0.94 to 1.22m): 5-inch standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out- swinging lockable doors.

5. Manufacturers:

a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - TA Series.

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120 inch (3mm) thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches (101.6mm). Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges where scheduled with Molex standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
1. Acceptable Manufacturers:
a. McKinney Products (MK) - QC (# wires) Option.

B. Concealed Power Transfers: Provide concealed electric power transfers where scheduled with Molex standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies.

1. Manufacturers:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) – EL- CEPT Series.
b. Securitron (SU) - EL-CEPT Series.

C. Door Cord: Provide surface applied door cord power transfers where scheduled with Molex standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable. 18" cord will be standard unless scheduled otherwise.
1. Acceptable Manufacturers:
   a. Securitron (SU) – TSB-C

D. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) – QC-C Series.

E. Door Cord: Provide surface applied door cord power transfers where scheduled with Molex standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable. 18 inch (0.46m) cord will be standard unless scheduled otherwise.

1. Manufacturers:

   a. Keedex (KX) –Part No. K-DL38A.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8 inches (203.2mm) in length and U.L. listed for labeled fire doors

and U.L. listed for windstorm components where applicable.

4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

B. Door Armor, Kick, Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum 0.050 inch (1.27mm) thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2-1/2 inches (63.5mm) from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2-1/2 inches (63.5mm) from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:

    a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.5 CYLINDERS AND KEYING

A. All key structures and final keying/installation of final keying will be purchased by the Contractor and installed / coordinated by the owner directly.

B. Construction Keying: Provide temporary green SFIC keyed cores. Include 2 control keys and 15 operating keys. Installer shall confirm functionality of lock and core as part of installation.

C. All locking devices shall accommodate 7 pin Small Format Interchangeable Cores (SFIC).

1. Acceptable Manufacturer:
    a. Best Patented – KABA-Peaks SFIC 7-pin key system. No substitutions are allowed.

D. Key Control Cabinet: Provide a high security key control box system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:
    a. Lund Equipment (LU).
    b. MMF Industries (MM).
    c. Telkee (TK).

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1

certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Acceptable Manufacturers:
    a. Sargent Manufacturing (SA) – 8200 Series. (no substitution)

B. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.

1. Acceptable Manufacturers:
    a. Sargent Manufacturing (SA) – 10 Line. (no substitution)

C. Lock Trim Design: As specified in Hardware Sets.

2.7 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.
2. Acceptable Manufacturers:
    a. Sargent Manufacturing (SA) - 8200 Series. (no substitution)

B. Electromechanical Cylindrical Locksets, Grade 1 (Heavy Duty): Subject to same compliance standards and requirements as mechanical cylindrical locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, and request-to-exit signaling. Unless otherwise indicated, provide electrified locksets standard as fail secure.
2. Acceptable Manufacturers:
    a. Sargent Manufacturing (SA) - 10G70/71 Series. (no substitution)

2.8 STAND ALONE ACCESS CONTROL LOCKING DEVICES

A. Stand Alone Locksets: ANSI A156.2, Series 4000, Grade 1 locking mechanism complete with integrated touchscreen or keypad as specified for access and programming. Voice-guided programming with 12-digit PIN code selection and up to 1000 user option. Locks to accept standard, small format interchangeable core, security and patented cylinders. Battery-operated, with low power indicator, or hard-wired (9 Volt external power supply) option.

1. Manufacturers:

a. Yale Commercial(YA) - nexTouch Series.

b. Simplex (SI) - L1000 Series.

2.9 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 andlisted and labeled for "Panic Hardware" according to UL 305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.

7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2 inch (50.8mm) wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:
   a. Sargent Manufacturing (SA) - 80 Series.
   b. Detex Corporation (DE) - Advantex.
   c. No substitution.

2.11 ELECTRIC STRIKES

A. Standard Electric Strikes: Heavy duty, cylindrical and mortise lock electric strikes conforming to ANSI/BHMA A156.31, Grade 1, UL listed for both Burglary Resistance and for use on fire rated door assemblies. Stainless steel construction tested for a minimum 1 million operating cycles. Provide strikes with 12 or 24 VDC capability and supplied standard as fail-secure unless otherwise specified. Provide latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike where specified.

1. Manufacturers:
   a. Folger Adam EDC (FO).
   b. HES (HS).

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five-year warranty.

2.12 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL 305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
5. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
6. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.
7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2 inch (50.8mm) wide stiles.
10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic

and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Sargent Manufacturing (SA) - 80 Series.
    b. Detex Corporation (DE) - Advantex.
    c. No substitution.

C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable- iron top and bottom retainers and a primed paint finish.

1. Provide keyed removable feature where specified in the Hardware Sets.
2. Provide stabilizers and mounting brackets as required.
3. Provide electrical quick connection wiring options as specified in the hardware sets.
4. Manufacturers:

    a. Sargent Manufacturing (SA) - 980S Series.
    b. No substitution.

2.13 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:
    1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
    2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
    3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
    4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
    5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
        a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
        b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
        c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
        d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as

required for proper mounting.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
7. Closers on Gates: Gate manufacturer to prepare gates with proper reinforcements and mounting surfaces for installation of closers where scheduled. Templates for proper reinforcements shall be provided by hardware supplier for reference upon request

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
   1. Acceptable Manufacturers:
      a. Sargent Manufacturing (SA) - 351 Series.
      b. Norton Door Controls (NO) - 7500 Series.

C. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA 156.4, Grade 1 certified surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Unitrol arms to have door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.
   1. Acceptable Manufacturers:
      a. Norton Door Controls (NO) - Unitrol 7500 Series
      b. No substitution.

2.14 ELECTROHYDRAULIC DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

   1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

   1. Opening Force if Power Fails: Not more than 15 lbf (66.72 N) required to release a latch if provided, not more than 30 lbf (133.45 N) required to manually set door in motion, and not more than 15 lbf (66.72 N) required to fully open door.

   2. Entrapment Protection: Not more than 15 lbf (66.72 N) required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Door Controls (NO) - 6000 Series.

2.15 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate.12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.
   1. Acceptable Manufacturers:
      a. Rixson (RF) - 980/990 Series.
      b. Sargent Manufacturing (SA) - 1560 Series.

2.16 ARCHITECTURAL TRIM

A. Door Protective Trim
   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
   2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2 inches (50.80mm) less than door width (LDW) on stop side of single doors and 1 inch (25.4mm) LDW on stop side of pairs of doors, and not more than 1 inch (25.4mm) less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16 inches (0.41m) above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
4. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), fabricated from the following:
   a. Stainless Steel: 300 series, 050-inchthick.
5. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
6. Acceptable Manufacturers:
   a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.17 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
   1. Acceptable Manufacturers:
      a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

   1. Acceptable Manufacturers:
      a. Rixson Door Controls (RF).
      b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
      c. Sargent Manufacturing (SA).

2.18 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on

testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:
1. Pemko Manufacturing (PE).

2.19 ELECTRONIC ACCESSORIES

A. Key Switches: Key switches furnished standard with stainless steel single gang face plate with a 12/24VDC bi-color LED indicator. Integral backing bracket permits integration with any 1 1/4" or 1 1/2" mortise type cylinder. Key switches available as momentary or maintained action and in narrow face plate options.
1. Acceptable Manufacturers:
a. Alarm Controls (AK) - MCK Series.

b. Securitron (SU) - MK Series.

B. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
1. Acceptable Manufacturers:
a. Securitron (SU) - AQD Series.

b. Altronix (AX) – Waypoint Series.

C. Push-Button Switches: Industrial grade momentary or alternate contact, back-lighted push buttons with stainless-steel switch enclosures. 12/24 VDC bi-color illumination suitable for either flush or surface mounting.

1. Manufacturers:

a. Securitron (SU) - EEB Series.

2.20 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

B. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

2.21 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General Contractor to examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
   2. Locks shall be equipped with temporary cores as specified and shall be confirmed to be functional and operational. Temporary keys shall be provided to owner upon completion of installation and verification of functionality.

B. Electrified Hardware: All electrified hardware is to be connected and electrically sound by the hardware installer, to include connections to local power supply, transfer hinge, power transfer, or door loop and installation of harness from power transfer to security junction box above door. All connections beyond the security junction box above door or associated local power supply are the responsibility of the security contractor.

C. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

D. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.6 DOOR HARDWARE SETS (GENERAL)

A. The hardware sets represent the design intent and direction of the Owner and Architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the Architect with corrections made

prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products and providing the correctoption for the appropriate door type and material where more than one is presented in the hardware sets. Quantities listed are for each pair of doors, or for each single door.

3.7 HARDWARE SETS

A. Set 1

1. Doors:
2. Description: EXTERIOR DOOR
3. Function: ELECTRIFIED TRIM EXIT DEVICE WITH EXTERIOR LEVER, FAIL OPEN, INTEGRATED REQUEST TO EXIT, STOREROOM FUNCTION

3	Hinge (Heavy Weight)
1	Electric Exit Device
1	Electrified Strike
1	Door Closer
1	Armor Plate
1	Threshold
1	Gasketing
1	Sweep

3.8 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

END OF SECTION 08 71 00

SECTION 08 91 19

FIXED LOUVERS

SECTION 089119 - FIXED LOUVERS

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:

1. Fixed, extruded-aluminum louvers.
2. Fixed, formed-metal acoustical louvers.

B. Related Requirements:
1. Section 099113 "Exterior Painting" for field painting louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver :

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. Air Balance Inc.; a Mestek company.
b. Air Flow Company, Inc.
c. Airolite Company, LLC (The).
d. All-Lite Architectural Products.
e. American Warming and Ventilating; a Mestek company.
f. Architectural Louvers; Harray, LLC.
g. Arrow United Industries; a division of Mestek, Inc.
h. Carnes Company, Inc.
i. Cesco Products; a division of Mestek, Inc.
j. Construction Specialties, Inc.
k. Dowco Products Group; Safe Air of Illinois.
l. Greenheck Fan Corporation.
m. Industrial Louvers, Inc.
n. Louvers & Dampers; a division of Mestek, Inc.
o. Metal Form Manufacturing, Inc.
p. NCA Manufacturing, Inc.
q. Nystrom, Inc.
r. Pottorff.
s. Reliable Products, Inc.
t. Ruskin Company; Tomkins PLC.
u. United Enertech.
v. Vent Products Co., Inc.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird & Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
2. Finish: Same finish as louver frames to which louver screens are attached
3. Type: Rewirable frames with a driven spline or insert, Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.
2. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
4. For fastening stainless steel, use 300 series stainless-steel fasteners.
5. For color-finished louvers, use fasteners with heads that match color of louvers.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.
   1. Color: As selected by Architect from full range of industry colors and color densities

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 91 19

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUBMITTALS:

A. Shop drawings; include the following:

1. Layout, including locations of lighting fixtures and grilles.
2. Insert and hanger spacing and fastening details.
3. Splicing method for main and cross runners.
4. Change in level details.
5. Support requirements for lighting fixtures, grilles and similar items.

B. Product data: Include product descriptions and installation instructions for each material. Indicate load carrying capacity of suspension system hanger spacings and manufacturer's recommended methods for fixture support.

C. Samples; submit the following:

1. 1'-0" by 1'-0" samples of each type and color acoustical material.
2. Samples of each type and color suspension member and accessory.

D. Certificates: Indicate compliance with specified requirements, including seismic requirements and UL fire-resistive ratings.

E. Evaluation reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.2 QUALITY ASSURANCE:

A. Applicable standards; standards as referenced herein:

1. American Iron and Steel Institute (AISI).
2. ASTM International (ASTM).
3. Ceiling & Interior Systems Contractors Association (CISCA).
4. Underwriters Laboratories, Inc. (UL).

B. Seismic performance: Comply with building code requirements.

C. Source limitations:

1. Acoustical ceiling panels: Obtain each type from single source from single manufacturer.
2. Suspension system: Obtain each type from single source from single manufacturer.

D. Source limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

E. Mock-up:

1. Install complete ceiling of each type specified, in space designated by Architect. Notify Architect when spaces are ready for observation.
2. Following Architect's acceptance, retain mock-up as a standard of quality for ceiling installation. Accepted mock-up may remain as part of finished work.

1.3 PROJECT/SITE CONDITIONS:

A. Sequencing and scheduling: Schedule acoustical material installation to minimize need for removal and replacement of acoustical units to accommodate work of other trades.

1.4 MAINTENANCE MATERIALS:

A. Furnish extra materials equal to one percent of each type of acoustical material supplied.

B. Furnish suspension system components in amount sufficient to install extra ceiling units.

PART 2 - PRODUCTS

2.1 METAL SUSPENSION SYSTEMS, GENERAL:

A. Metal suspension system standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C635-13a.

B. Carrying channels: 16 ga. cold-rolled steel, 1-1/2" deep.

C. Attachment devices: Size for five times the design load indicated in ASTM C635-13a, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E488-10 or ASTM E1512-01(2007) as applicable, conducted by a qualified testing and inspecting agency.

    a. Type: Cast-in-place anchors.
    b. Corrosion protection: Carbon-steel components zinc plated to comply with ASTM B633-13, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

2. Power-actuated fasteners in concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E1190-11, conducted by a qualified testing and inspecting agency.
3. Hanger clips: Prefabricated metal clamps for fastening to building structure.

D. Wire hangers, braces, and ties: Provide wires complying with the following requirements:

1. Zinc-coated, carbon steel wire: ASTM A641-09a(2014), Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C635-13a, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

E. Angle hangers: Angles with legs not less than 7/8" wide; formed with 0.04" thick, galvanized-steel sheet complying with ASTM A653-13, G90 Z275 coating designation; with bolted connections and 5/16" diameter bolts.

F. Seismic components: Provide as required by building code:

1. Seismic stabilizer bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
2. Seismic struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
3. Seismic clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

G. Special shapes:

1. Acceptable manufacturers; subject to compliance with specified requirements:

a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.

2. Characteristics: Aluminum acoustical moldings, shapes as indicated; white color.

2.2 STEEL SUSPENSION SYSTEMS:

A. Acceptable manufacturers; subject to compliance with specified requirements:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Rockfon.
4. USG Interiors, Inc.

B. Exposed steel grid system; 15/16" flange face.

1. Structural classification: Meeting ASTM C635-13a, Intermediate Duty.
2. Module: 2'-0" by 2'-0".
3. Main and cross tees:

a. Tee material: Hot dip galvanized, cold-rolled steel.
b. Cap material: Hot dip galvanized, cold-rolled steel.
c. Design: Double web.
d. Tee size: 15/16" flange face width; 1-1/2" nominal height main tees.

1) 2'-0" or 4'-0" long cross tees for interior applications.
2) Material thicknesses shall be as required to meet specified structural classifications.

4. Edge molding:

a. Minimum 0.020" thickness galvanized steel, channel or angle shaped, hemmed edges.
b. Flange widths:

1) Non seismic category areas: Minimum 3/4".
2) Seismic category C: Minimum 7/8" (or use vertical perimeter wires not more than 8" from wall).
3) Seismic categories E, D and F: Minimum 2".

5. Finish on exposed components: Chemically treated for paint adhesion with factory-applied, low-gloss white paint.

2.3 ACOUSTICAL CEILING PANELS:

A. Acceptable manufacturers; subject to compliance with specified requirements:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. USG Interiors, Inc.

B. Basis of design: As scheduled on drawings. Acoustical ceiling panels of similar design and construction, as manufactured by other acceptable manufacturers, may be submitted for Architect's consideration. Acceptance is subject to compliance with specified design criteria, as evidenced by submittal of specified product data, and Architect’s approval.

C. Characteristics:

1. Size: 2'-0" by 2'-0".
2. Thickness: 5/8".
3. Edges: Square.
4. Finish: Factory-applied, washable paint.

2.4 ACCESSORIES:

A. Acoustical sealant:

1. Acoustical sealant for exposed and concealed joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834-14 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90-09.
2. Acoustical sealant for concealed joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, syntheticrubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
3. Sealant shall have a VOC content of 250 g/L or less.

B. Sound attenuation blankets: 1-1/2" thickness, minimum 2-1/2 lb. density, paperless, semi-rigid, mineral fiber blanket.

C. T-Grid support clip:

1. Acceptable products:

a. Armstrong World Industries, Inc., Beam End Retainer Clip Item 7395.
b. Rockfon, 1493 Unopposed Tee Clip.

c. Erico Products, Inc., Caddy TGE T-Grid support clip.
d. USG Industries, Inc., Mac 2.

2. Characteristics: Mechanical clip for attaching acoustical “T” to edge molding without exposed fasteners in grid system.

PART 3 - EXECUTION

3.1 SUSPENSION SYSTEM INSTALLATION:

A. Install suspension system in accord with manufacturer’s product data, ASTM C636-13, ASTM E580-14 and CISCA recommendations, except for more stringent requirements specified herein.

B. Layout:

1. Center grid system within areas to avoid panels ** and tiles ** of unequal widths at opposite walls and panels ** and tiles ** of less than 1/2 width.
2. Align grid members straight and perpendicular to walls.

C. Seismic requirements:

1. Comply with building code for seismic restraint requirements.
2. Install suspension systems in accord with ASTM E580-14 and ASCE 7-10.
3. Lateral bracing: In addition to complying with ASTM C636-13, ASTM E580-14 and ASCE 7-10, install suspension systems in accord with CISCA 0-2 for Seismic Design Category C, CISCA 3-4 for Seismic Design Categories D, E, and F, and applicable building code requirements.
4. Perimeter requirements:

a. Category C: Where perimeter angle is less than 7/8", provide perimeter vertical hangar wires not less than 8" from wall.
b. Categories D, E and F: Provide perimeter vertical hangar wires not less than 8" from wall.
c. Grid end/wall details:

1) Category C: Minimum 3/8" clearance on all 4 walls.
2) Categories D, E and F: Two adjacent walls shall be tight and two adjacent walls shall have a minimum 3/4" clearance.

D. Hangers:

1. Space hangers for carrying channels or main tees at 4'-0" o. c. maximum. Secure to building structure.

2. Install additional hangers at ends of each suspension member, within 6" of end of member or wall.
3. Install additional hangers within 6" of each corner of lighting fixtures, grilles and similar items.
4. Splay wires no more than 5" in 2'-6" vertical drop.
5. Where spacing of hangers for main tees exceeds maximum specified spacing due to interference by adjacent construction, indirect-hang tees using carrying channels to maintain maximum hanger spacing.
6. Wrap wire minimum of three times horizontally, turning ends upwards.

E. Carrying channels: Saddle-tie carrying channels to main structure for indirecthung suspension system.

F. Direct-hung, exposed grid system, 2'-0" by 2'-0" module:

1. Space main tees at 4'-0" o. c., maximum, perpendicular to structure.
2. Locate cross tees at 2'-0" o. c., perpendicular to main tees.
3. Space cross tees at 2'-0" o. c., perpendicular to previously installed cross tees, to form 2'-0" by 2'-0" grid module. Connect to cross tees through slots in main tees.

G. Level and square suspension system components within specified tolerances prior to beginning ceiling material installation.

H. Install cross tees adjacent to lighting fixtures and grilles on each side not supported by main tees. Support no fixtures on main or cross tees when fixture weight results in dead load exceeding deflection capacity of suspension system.

I. Where cut tees intersect other tees or edge moldings without mechanical attachment, attach components using T-Grid support clip. At contractor’s option tees may be attached directly to partition with tie wire.

J. Wall moldings:

1. Install wall molding at intersection of suspended ceiling and vertical surfaces.
2. Miter corners where wall moldings intersect or install corner caps.
3. Attach to vertical surfaces with mechanical fasteners.
4. Apply continuous ribbon of acoustical sealant on vertical web.
5. In each orthogonal horizontal direction, attach one end of ceiling grid to closure angle. The other end in each horizontal direction shall have 3/4" clearance from wall and shall rest upon and be free to slide on closure angle.

K. Where grid system exists in an unrestrained condition, brace back to building structure using hanger wire, main tee or carrying channel braces spaced at 4'-0" o. c., maximum.

3.2 ACOUSTICAL UNIT INSTALLATION:

A. Install acoustical units in level plane, in straight line courses, within specified tolerances.

B. Place acoustical materials to bear all around on suspension members.

C. Pattern shall be symmetrical about centerline of area, unless otherwise indicated. Lay out units having directional pattern in same direction.

D. Seal joints in acoustical units around pipes, ducts, and ducts and electrical outlets with acoustical sealant.

E. Where cutting of acoustical units is required, cut so that no cut or damaged edges are visible in finished work.

F. Hold-down clips: Install acoustical units surrounding recessed troffer lights with hold-down clips to prevent movement or displacement of units.

G. Lay sound attenuation blankets over ceilings in designated spaces.

H. Allowable tolerances:

1. Deflection: Suspension system components, hangers and fastening devices supporting lighting fixtures, ceiling grilles and acoustical units shall have maximum deflection of 1/360 of the span when tested in accord with ASTM C635-13a.
2. Bow, camber and twist: Not exceeding tolerances established by ASTM C635-13a.
3. Variation from level in finished ceiling: ±1/8" in 12'-0".

3.3 CLEANING:

A. Clean soiled or discolored unit surfaces after installation.

B. Touch up scratches, abrasions, voids and other defects in painted metal surfaces.

C. Remove and replace damaged and stained acoustical units with new units.

END OF SECTION 09 51 00

SECTION 09 90 00

PAINT AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes
1. Surface preparation.
2. Field application of paints, stains, and other coatings.
3. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   a. Exterior face of concealed CMU block exterior wall to be painted with block filler per IECC requirements for air and weather barrier.

B. Paint exposed surfaces whether or not colors are designated in Finish Schedule, except where a surface or material is specifically indicated not to be painted or is to remain natural. If color or finish is not designated, the Architect will select from standard colors or finishes available.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
1. Prefinished items not to be painted include the following factory-finished components:
   a. Acoustic materials.
   b. Finished mechanical and electrical equipment.
   c. Light fixtures.
   d. Switchgear.
   e. Distribution cabinets.
2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
   a. Foundation spaces.
   b. Furred areas.
   c. Pipe spaces.
   d. Duct shafts.
3. Finished metal surfaces not to be painted include:
   a. Anodized or mill finished aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze.
   f. Brass.
4. Operating parts not to be painted include moving parts of operating equipment such as the following:
   a. Valve and damper operators.
   b. Linkages.

c. Sensing devices.
d. Motor and fan shafts.

5. Other Items:
   a. Pipes, ducts, valves, fittings, conduits, fans, and insulation, in areas above suspended ceilings.
   b. Striping of exterior pavements.
6. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
7. Extra and excess materials indicated.

1.2 REFERENCE STANDARDS

A. 49 CFR 59, Subpart D – National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental protection Agency; current edition.

1.3 SUBMITTALS

A. Product Data: Provide data on all finishing products, including VOC content.

B. Samples: Submit two painted samples, illustrating selected colors for each color and system selected. Submit on durable sheet material, 8 x 11 inch in size.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. Extra Paint and Coatings: 2 gallons of each color; store where directed.
2. Label each container with color in addition to the manufacturer's label.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Installation: Installation by skilled commercial painters with not less than five (5) years of continuous experience with materials equal in quality on projects of comparable scope. A satisfactory crew of qualified painters shall be maintained throughout the duration of the work.

C. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List".
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

D. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
   a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
   b. Other Items: Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
   a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

E. Materials:
1. Provide ready-mixed paints and stains. Job mixing and tinting is not acceptable.
2. Provide lead free materials with mildew and mold resistant top coatings.
3. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer's testing and field experience.
4. Minimum dry film thickness (dft) for each coat is listed in millimeters (mils) in the Material Schedule within this Section.

F. Material Quality: Provide manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Federal Specification number, if applicable.
4. Manufacturer's stock number and date of manufacture.
5. Contents by volume, for pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.
9. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.6 PROJECT CONDITIONS

A. Storage: Store materials not in use in tightly covered containers in a well- ventilated area at a minimum ambient temperature of 45 deg F. Maintain stored containers in a clean condition, free of foreign materials and residue. Protect from freezing.
   1. Deliver painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating, color designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.
   2. Take necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect environment from hazard spills. Store all materials that constitute a fire hazard (paints, solvents, drop cloths, etc.) in suitable closed and rated containers. Post adequate warnings (e.g. no smoking) as required.
   3. Keep storage areas neat and orderly. Remove oily rags and waste daily, and dispose of off-site in a manner approved by authorities having jurisdiction.

B. Environmental Conditions:
   1. Apply waterborne paints and finishes only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
   2. Apply solvent-thinned paints and finishes only when temperatures of surfaces to be painted and surrounding air are between 45 F.
   3. Do not apply paint or finish material in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Work Conditions:

   1. Coordinate with other trades to ensure adequate illumination, ventilation and dust-free environment during paint and finish application and drying. Maintain temperature and humidity within manufacturer's recommended tolerances throughout the work.
   2. Before commencing work on any surface type, carefully inspect same and verify they are clean, dry and in all other respects suitable to receive specified treatment. Use cleaning materials and methods appropriate for substrate and field conditions.
   3. Protection and Cleaning: Provide clean drop cloths, and other protection as approved, to protect floors, doors, windows and other parts from damage. Where any work is splattered, clean promptly and leave in satisfactory condition.
   4. Use no plumbing fixtures, open waste or vent pipe, or pipe of any kind to dispose of paint, used rags, waste or other materials.
   5. Water closets, tubs, and other fixtures, cabinets, furniture, etc., shall not be used as supports for planking, and shall be thoroughly protected from damage at all times.
   6. Mixed species of wood occurring within the same room or adjacent to one another shall be finished to match the selected species and finish.

D. Concrete Slab Curing Materials and Methods: Review concrete slab curing and sealing material submittals provided by General Contractor for compatibility with floor coating materials provided under this Section. Notify General Contractor, in writing, of materials' compatibility or non-compatibility with floor coating materials provided under this Section. Proceed with installation only after compatible materials and/or curing methods have been approved, or non-compatible curing or sealing materials have been removed by the General Contractor.

E. Waste Management and Disposal:
   1. Paint, stain and wood preservative finishes and related materials (thinners, solvents, etc.) are regarded as hazardous products and subject to regulations for disposal. Obtain information on required controls from applicable authorities having jurisdiction.
   2. Collect, separate and recycle waste materials where recycling is available. Treat materials that cannot be reused as hazardous waste and disposed of in an appropriate manner.
   3. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated on-site for hazardous waste.
   4. The following procedures shall be strictly adhered to:
      a. Retain cleaning water for water based materials to allow sediments to be filtered out. In no case shall equipment be cleaned using free draining water.
      b. Retain cleaners, thinners, solvents and excess paint, and place in designated containers and ensure proper disposal.
      c. Return solvent and oil soaked rags for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
      d. Dispose of contaminants in an approved legal manner in accordance with hazardous waste regulations.
      e. Empty paint cans are to be dry prior to disposal or recycling (where available).
      f. Close and seal tightly partly used cans of materials, including sealant and adhesive containers, and store in ventilated, fire safe areas at moderate temperatures.
   5. Set Aside and protect surplus and uncontaminated finish materials not required by Owner, and arrange collection for verifiable reuse or remanufacturing.

F. Unless specifically noted, do not paint or finish prefinished items and surfaces, concealed surfaces, operating parts and the following:
   1. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating or nomenclature plates.
   2. Architectural Features: Aluminum doors, frames and windows, finish hardware, and copper, stainless steel or aluminum fabrications.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied, and that are packaged for storage and identified with labels describing contents. Deliver extra materials to Owner.
   1. Quantity: Furnish an additional 3 percent, but not less than 1 gal. of each material and color applied.

B. Excess Materials: In addition to extra materials noted above, turn over unused paint and finish materials to the Owner's representative. Package materials with protective covers for storage and identify with labels describing contents and color.

C. Provide a typed list of extra and excess materials and turn over to the Owner's representative.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Materials selected for coating systems for each type surface shall be the product of a single manufacturer. The Basis of Design is Sherwin Williams unless otherwise specified. Except as otherwise specified, materials shall be the products of the following manufacturers, and as indicated on the Drawings:
   1. Sherwin Williams
   2. Benjamin Moore
   3. PPG
   4. Glidden

B. Note: All coatings must comply with current VOC regulations.

C. Paints and coatings must comply with one or more of the certifications for VOC emissions verification: either GREENGUARD GOLD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings, or are CDPH v1.1-2010 (LEED v4) Emission Certified by the California Department of Public Health (CDPH) Standard Method, and meet the VOC limits per CARB.

2.2 GENERAL

A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
   1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each coating material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.

C. Volatile Organic Compound (VOC) Content:
   1. Provide coatings that comply with the most stringent requirements specified in the following:
      a. 40 CRF 59, Subpart D – National Volatile Organic Compound Emission Standards for Architectural Coatings.
      b. Architectural coatings VOC limits of State in which the project is located.
   2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

D. Coating Material Compatibility: Provide block fillers, primers, under-coaters, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

E. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

F. Chemical Components of Field-Applied Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:
1. Flat Paints and Coatings: VOC content of not more than 100 g/L.
2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
3. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
4. Restricted Components: Paints and coatings shall not contain any of the following:
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
   w. Toluene (methylbenzene).
   x. 1,1,1-trichloroethane.
   y. Vinyl chloride.

2.3 PAINT SYSTEMS – EXTERIOR

A. Ferrous Metals, Primed, Alkyd, 2 Coat:
1. Touch up factory primer with rust-inhibitive primer recommended by top coat manufacturer.
2. Gloss: Two coats of low-VOC advanced thermoset solution fluoropolymer semi-gloss enamel;

a. Basis of Design: TNEMEC Low VOC “Hydroflon” series 701 or equal by PPG.

B. Galvanized Metals, Alkyd, 3 Coat:
1. One coat Galvanize primer.
a. Benjamin Moore: MO7 I.M.C. Universal Alkyd Metal Primer.
b. Devoe: 4160 Tank and Structural Primer.
c. PPG: 90-712 Pitt-Tech Acrylic Metal Primer
d. Sherwin Williams: B50WZ3 Galvite Galvanized Metal Primer.
2. Gloss: Two coats of alkyd enamel:
a. Benjamin Moore: 133 Impervo Alkyd High Gloss Enamel.
b. Devoe: 4160 Tank and Structural Primer.
c. PPG: 7-282 Pittsburgh Paints Industrial Oil Gloss
d. Sherwin Williams: B54Z Industrial Alkyd Gloss Enamel.

C. Masonry, Opaque, Latex, 1 Coat: (Low VOC)
1. One coat of block filler.
a. Benjamin Moore: Eco Spec Interior Latex Primer Sealer 231 (0 g/L VOC).
b. Glidden: 3010-1200 Blockfiller (<100 g/L VOC).
c. PPG: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC).
d. Sherwin Williams: S-W Loxon Acrylic Masonry Primer, A24W8300.

2.4 PAINT SYSTEMS – INTERIOR – LOW VOC

A. Masonry, Opaque, Latex, 3 Coat: (Low VOC)
1. One coat of block filler.
a. Benjamin Moore: Eco Spec Interior Latex Primer Sealer 231 (0 g/L VOC).
b. Glidden: 3010-1200 Blockfiller (<100 g/L VOC).
c. PPG: PPG 6-7 Speedhide Acrylic Latex Block Filler (14 g/L VOC).
d. Sherwin Williams: S-W Loxon Acrylic Masonry Primer, A24W8300.
2. Semi-gloss: Two coats of latex enamel;
a. Benjamin Moore: Eco Spec Interior Semi-Glass Enamel 224 (11 g/L VOC).
b. Glidden: 9200 Lifemaster No VOC Semi-Gloss Interior (0 g/L VOC).
c. PPG: PP6139 Pro Master 2000 Latex Semi-Gloss Enamel (108 g/L VOC).
d. Sherwin Williams: S-W ProMar 200 Zero VOC Latex Semi-Gloss.

B. Ferrous and Galvanized Metals, Primed, Acrylic Enamel, 2 Coat: (Low VOC)
1. Touch up with acrylic primer.
a. Benjamin Moore: Super Spec HP, Acrylic Metal Primer
b. Glidden: 4020-1000 Devflex DTM primer (91 g/L VOC).
c. PPG: 90-712 Pitt Tech DTM Acrylic Metal Primer (123 g/L VOC).
d. Sherwin Williams: B66-310 Series Pro Industrial ProCryl Universal Primer.
2. Semi-gloss: Two coats of acrylic enamel;
a. Benjamin Moore: M29 I.M>C> DTM 100% Acrylic Semi-Gloss Enamel
b. Glidden: 9200 Lifemaster No VOC Semi-gloss Interior (0 g/L VOC)
c. PPG: 7-374 Pittsburgh Paints Semi Gloss Acrylic Metal Finish (82 g/L VOC).
d. Sherwin Williams: B42 Series Metalatex Semi-Gloss

C. Epoxy Floor Finish at Concrete Floor at Janitor Closets, Ablution Rooms, Remote Restrooms, Storage and Maintenance Rooms.

1. Basis of Design: Dura-Cote, Inc. Dur-A-Quartz system. Refer to the Drawings for additional information.
2. Or as approved by the Architect.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide all primers, sealers cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.

B. Patching Material: Latex filler.

C. Fastener Head cover Material: Latex Filler.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. Application of primers, paints, stains or finishes represents acceptance by the contractor that the surfaces were properly prepared and suitable for application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   a. Concrete floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to coating application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Remove mildew from impervious surfaces by scrubbing with solution of tetra- sodium

phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.

I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.

K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

L. Metal Doors to be painted: Prime metal door top and bottom edge surfaces.

M. Note: Concrete wall panels are to be backerolled with each coat. panels are to be pressure washed prior to painting to remove all contaminants.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Dark Colors and Deep Clear colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.

E. Apply paint, enamel, stain and varnish with suitable brushes, rollers or spraying equipment.
1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved.
2. Keep brushes and rollers and spraying equipment clean, dry, free from contaminates and suitable for the finish required.
3. Apply stain by brush.

F. Finish coats shall be smooth, free of brush marks, streaks, laps or pile up of paints and

skipped or missed areas.

G. Leave all parts of moldings and ornaments clean and true to details with no undue amount of paint in corners and depressions.

H. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

I. Change colors at corner of stop where colors differ between adjoining spaces or rooms and where door frames match wall colors.

J. Where portion of finish or drywall partition is damaged or unacceptable, refinish entire surface of partition.

K. Back-prime exterior carpentry and millwork with material specified for prime coat, without runs on face. Finish cut edges just prior to installation.

L. Finish all edges of exterior doors same as faces.

M. The number of coats specified are minimum. The Contractor shall provide at no additional cost to the Owner, as many coats as necessary for color coverage conformity and uniform appearance. See 3.6 below for specific application requirements

N. Sand metal surfaces lightly between coats to achieve required finish.

O. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

A. Protect finished coatings until completion of project.

B. Touch up and restore finish where damaged. Remove spilled, splashed or splattered paint from all surfaces.

C. Do not mar surface finish of item being cleaned.

3.6 SCHEDULE – SURFACES TO BE FINISHED

A. Do Not Paint or Finish the Following Items:
1. Items fully factory-finished unless specifically noted.
2. Fire rating labels, equipment serial number and capacity labels.
3. Stainless steel items.

B. Exterior Surfaces to be painted:
   1. All hollow metal doors and frames.
   2. CMU walls with block filler per IECC requirements for AWB.
   3. All bollards.
   4. All exposed piping.
   5. Gas piping on roof.
   6. Downspout guards.
   7. Structural Steel
   8. Piping, conduit, and ductwork unless specifically noted.
   9. All other exposed metal except prefinished items.

C. Interior Surfaces to be painted:
   1. All walls scheduled for paint.
   2. All hollow metal doors and frames.
   3. Floors where noted scheduled or indicated.

D. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment. Leave documentation/ proof of rating stamp for inspection if painting occurs prior to inspection.

END OF SECTION 09 90 00

SECTION 09 96 00

HIGH-PERFRMANCE COATINGS

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 surface preparation and application of high-performance coating systems.

1. Exterior Substrates:
   a. Steel.
   b. Galvanized metal.

2. Interior Substrates:

   a. Concrete, vertical and horizontal surfaces.
   b. Concrete masonry units (CMU).
   c. Steel.
   d. Galvanized metal.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.

1.3 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than [1 gal. (3.8 L)] of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.

a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Behr Process Corporation.
2. Benjamin Moore & Co.
3. Bennette Paint Mfg. Co., Inc.
4. Betonel Ltd.
5. BLP Mobile Paint Manufacturing Company, Inc.
6. Cloverdale Paint.
7. Color Wheel Paints & Coatings.
8. Columbia Paint & Coatings.
9. Conco Paints.
10. Coronado Paint.
11. Diamond Vogel Paints.
12. Dunn-Edwards Corporation.
13. Duron, Inc.
14. Euclid Chemical Company.
15. Farrell-Calhoun.
16. Frazee Paint.

17. General Paint.
18. Hirshfield's, Inc.
19. ICI Paints.
20. ICI Paints (Canada).
21. Insl-x.
22. Kelly-Moore Paints.
23. Kwal Paint.
24. M.A.B. Paints.
25. Microblend Technologies Inc.
26. Miller Paint.
27. Mills Paint.
28. PARA Paints.
29. Parex LaHabra Inc.
30. Parker Paint Mfg. Co. Inc.
31. PPG Architectural Finishes, Inc.
32. Pratt & Lambert.
33. Rodda Paint Co.
34. Scott Paint.
35. Sherwin-Williams Company (The).
36. Sico, Inc.
37. Vista Paint.
38. Zinsser.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.
7. Floor Coatings: 100 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.

c. Wood: 15 percent.
d. Gypsum Board: 12 percent.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Plaster Substrates: Verify that plaster is fully cured.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water.
2. Abrasive blast clean surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."

E. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Retain "Shop-Primed Steel Substrates" Paragraph below if primers are shop applied and will not be removed in the field.

H. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

J. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. CMU Substrates:

1. Epoxy System:

a. Block Filler: Block filler, epoxy
b. Intermediate Coat: Epoxy, gloss
c. Topcoat: Epoxy, gloss

B. Steel Substrates:

1. High-Build Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal
b. Intermediate Coat: Epoxy, high-build, low gloss
c. Topcoat: Epoxy, gloss

C. Galvanized-Metal Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal.
b. Intermediate Coat: Epoxy, gloss.
c. Topcoat: Epoxy, gloss.

3.7 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. Epoxy System:

a. Prime Coat: Epoxy, gloss
b. Intermediate Coat: Epoxy, gloss
c. Topcoat: Epoxy, gloss

B. Concrete Substrates, Horizontal Surfaces.

1. Clear Two-Component Polyurethane System:

a. Prime Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)
b. Intermediate Coat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)
c. Topcoat: Varnish, aliphatic polyurethane, two-component (Gloss Level 6 or 7)

C. CMU Substrates:

1. Epoxy System:

a. Block Filler: Block filler, latex, interior/exterior
b. Block Filler: Block filler, epoxy
c. Intermediate Coat: Epoxy, gloss
d. Topcoat: Epoxy, gloss

D. Steel Substrates:

1. High-Build Epoxy System:

a. Prime Coat: Primer, zinc-rich, epoxy
b. Intermediate Coat: Epoxy, high-build, low gloss
c. Topcoat: Epoxy, gloss
d. Topcoat: Epoxy, high-build, low gloss

E. Galvanized-Metal Substrates:

1. Epoxy System:

a. Prime Coat: Primer, epoxy, anti-corrosive, for metal
b. Intermediate Coat: Epoxy, gloss
c. Topcoat: Epoxy, gloss

END OF SECTION 09 96 00

SECTION 133423

FABRICATED STRUCTURES

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 prefabricated Freestanding, shop fabricated fiberglass reinforced plastic (FRP) buildings including the following:
   1. Doors and frames
   2. Structural steel base.
   3. Electric service.
   4. Lighting.
   5. HVAC.

B. Related Sections:

   1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts.
   2. Section 055000 "Metal Fabrications" for pipe bollards to protect composite building.

C. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."

1.3 PERFORMANCE REQUIREMENTS

A. Cooperate with regulatory agency or authority and provide data as requested by authority having jurisdiction.

B. Prefabricated structures and shelters specified herein shall be handicapped accessible in accordance with ICC/ANSI A117.1 and other state and local requirements as applicable.

C. Design to sustain superimposed loads for load combinations in accordance with ASCE 7 and as applicable at the location of the project.

D. Design to withstand effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Determine loads based on the following minimum requirements:
      a. Dead load of building.
      b. Mechanical equipment.
      c. Uniform pressure as indicated on Drawings.
      d. Wind Load: As indicated on Drawings.
      e. Snow Load: As indicated on Drawings.
      f. Live Load: As indicated on Drawings.
   2. Stresses produced by specified load conditions shall be determined consistent with recognized methods of analysis.

E. Energy Code: Meet energy code requirements for state where structure resides.

F. Average R Value of Assembled Building: R-20.

G. Electrical Devices: Devices UL listed with wiring bearing UL classification and conforming to the current NEC.

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Certificates: Product certificates signed by the manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.
   1. Welding certificates.

2. Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
    a. Project name.
    b. Manufacturer.
    c. Contractor.
    d. Dimensions of building.
    e. Governing building codes.
    f. Design loads.
    g. Load combinations.
    h. Building use categories.

F. Warranty Documentation: For warranty as specified herein.

1.5 INFORMATIONAL SUBMITTALS

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: To include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing FRP prefabricated structures with a minimum documented experience of five years.

B. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

C. Prefabricated Components: Comply with manufacturer's published literature for products meeting indicated design loads in accordance with state and local requirements as applicable.

D. Preconstruction and Preinstallation Meetings: Conduct meetings to verify project requirements, substrate conditions, utility connections, manufacturer's installation instructions, and warranty requirements. Comply with Division 1 requirements.

1.8 COORDINATION

A. Coordinate installation of anchorages for control booths. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Shrink-wrap the completed structure or building components with protective plastic for shipment to and storage at the job site.
   1. Support structure for shipment and handling to prevent warping and fracturing.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Protect all components and accessories from corrosion, deformation, damage and deterioration when stored at job site. Keep materials free from dirt and foreign matter.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.11 WARRANTY

A. Manufacturer's Warranties: Provide manufacturer's 1-year limited warranty on products of its manufacture to be free of leaks and defects in materials and workmanship from date of shipment.

B. Provide manufacturer's warrantees on all accessory items provided such as, but not limited to, lighting, doors, windows, and HVAC equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. BASIS OF DESIGN: Mekco a division of ConceptWorks, which is located at: 11110 Hwy. 42; Newton, WI 53063; Tel: 920-693-8163; Fax: 920-693-8165; Email: build@mekco.com; Web:www.mekco.com; or comparable product by one of the following:
   1. Shelter Works
   2. Tracom
   3. Open Channel Flow
   4. Global Treat, Inc.

2.2 MATERIALS

A. Resin:
   1. COR61-AA-545 Resin as manufactured by Interplastic Corporation. or equivalent.

2. Orthophthalic polyesters. Fillers and additives may be used to achieve chemical resistance and fire-retardant properties specified.
3. Suitable for Service Temperature Range: Minus 30 to 140 degrees F (minus 1 to 60 degrees C).

B. Gel Coat: Isophthalic NPG, UV- stable, chalk resistant.
1. Manufacturer: LHM-2900 Low Hap White HydroShield LITE, NPG/ISO Marine Gel Coat as manufactured and supplied by HK Research Corporation or equivalent.
2. Color: As selected by the Architect from manufacturer's standard selections.

C. Glass Fiber Reinforcing: Type E glass and treated with finish compatible to resin being used.
1. Glass Fiber Chopped Roving: Manufactured by PPG, Owens Corning, or equivalent. Used for making random fibers 1-1/4 inch (32 mm) in length.
2. Stitch Mat: Type CM-2415 or CDM-2415 manufactured by BTI, Knytex, or equivalent.

D. Insulation: Ridged polyisocyanurate urethane foam designed for permanent thermal insulation.
1. Functional Temperature Range: Minus 300 to 300 degrees F (Minus 184.4 to 148.9 degrees C).
2. Thickness: Minimum required to obtain R-20 rating.

2.3 FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

A. Wall and Roof Building Panels: High gloss molded to desired structural architectural shapes.
1. Insulated FRP Laminate Panels: Two, 1/8 inch (3 mm) thick skins sandwiching a core of insulation.
a. Isophthalic NPG Exterior Gel Coat: 18 mils (0.457 mm) minimum.
b. Glass Fiber Chopped Roving: 1-1/4 inch (32 mm) random fiber (minimum glass content to be 35 percent by weight.
c. Polyester structural laminating resin.

d. Core Insulation: Solid polyisocyanurate urethane insulation.
2. Panel Flanges: Minimum 1/4 inch (6 mm) FRP laminate.
3. Perimeter Anchoring Flanges: 1/4 inch (6 mm) minimum thickness FRP laminates.
a. One layer of stitch mat laminated within the anchoring flange.
4. Detachable roof.

B. FRP Panel Properties:
1. Barcol Hardness: 35 minimum.
2. Laminates with Stitch Mat and Random Chopped Fibers Warp Direction: Minimum values.

a. Tensile Strength: 61,400 psi (423338.1 kPa).
b. Tensile Modulus: 2.98 msi (20.54 gPa).
c. Compressive Strength: 44,500 psi (306816.7 kPa).
d. Compressive Modulus: 2.28 msi (15.72 gPa).
e. Flexural Strength: 73,700 psi (508143.6 kPa).
f. Flexural Modulus: 2.35 msi (16.20 gPa).

3. Laminates with Random Chopped Fibers: Minimum values.
a. Tensile Strength: 12,500 psi (86184.5 kPa).
b. Tensile Modulus: 1.1 msi (7.58 gPa).
c. Compressive Strength: 22,700 psi (156511 kPa).
d. Compressive Modulus: 1.04 msi (7.17 gPa).
e. Flexural Strength: 23,800 psi (164095.2 KPa).
f. Flexural Modulus: 0.97 msi (6.69 gPa).

C. Fabrication:
1. Form individual segments on high gloss molds ensuring consistent dimensions of finished parts. Cast each segment in one piece.
2. Laminate shall consist of alternating layers of stitch mat and/or chopped roving impregnated with resin.
3. Form panel flanges and perimeter anchoring flanges to the interior of the building.
4. Insulation: Bonded to interior and exterior laminate with resin.
a. Panels without a continuous and consistent bond between insulation and laminate are not acceptable.
5. Interior Finish: White corrosion resistant FRP.
6. Exterior Finish: Color as selected by the Architect from manufacturer's standard selections.

2.4 DOORS AND FRAMES

A. Doors and Frames (Grade II - Economy): FRP/Aluminum.
1. Doors and frames: Industrial grade aluminum frame construction.
2. Double panel 6068.
3. Insulated between two FRP door panel skins.
4. Hardware: Heavy-duty stainless steel.
5. Triple Butt Hinges: 4 x 4 inch (102 x 102 mm).
6. Closer/Hold Open Devices: Pneumatic.
7. Inactive Leaf: Top and bottom bolts.
8. Weather stripping.
9. Seals: Threshold and header.
10. Rain drip edge.
11. Commercial lockset.

2.5 STRUCTURAL STEEL BASE

A. Base Material: 2 to 6 inch (51 to 152 mm) structural tube, channel, or angle steel welded frame and structural steel subflooring.
   1. Seamless .250 in (6 mm) flat deck plate
   2. Fork and crane liftable.
   3. Offset Steel Hold Down Lug Plates: 4, quarter-turn 6 x 4 x 1/4 in (152 x 102 x 6 mm).
   4. Epoxy painted, all surfaces
   5. Color: As selected by the Architect from manufacturer's standard selections.

2.6 MISCELLANEOUS ITEMS

A. Concrete Stainless Steel Anchor Bolts: Minimum 3/8 inch (9 mm). Diameter.
   1. Oversized Stainless Steel Plate Washers: Used to prevent localized stressing of the base flange.

B. Connection of Building Panels:
   1. Permanently fused building assembly yielding a watertight one-piece structure.

C. Base Gasket:
   1. Soft, closed cell, neoprene foam gasket material.
   2. Suitable for exposure to weather conditions at building location.
   3. Suitable for exposure to sewage and sewage gases.
   4. Thickness: 3/8 inch (9 mm) minimum.

D. Wall and Roof Gasket:
   1. Soft PVC.
   2. Suitable for exposure to weather conditions at building location.
   3. Suitable for exposure to sewage and sewage gases.
   4. Thickness: 1/4 inch (6 mm) minimum.

2.7 ELECTRIC SERVICE

A. Electrical Power Service: Provide in accordance with NEC Standards. 125 amp, 120/240 VAC, single-phase, 3-wire service with 8-16 circuit breaker panel.
   1. Copper wiring in surface mounted 1/2 inch (13 mm) minimum EMT conduit.
   2. Receptacles: 120-V GFCI power duplex receptacle with tester.
   3. Receptacles: 120-V spec grade power duplex receptacle.

B. Electrical Conduits: Class 1, division 1 and 2 locations. Listed and labeled as defined in NFPA 70.
   1. Metallic Conduit:
      a. EMT: Electrical metallic tubing Per ANSI C80.3 and UL 797.
      b. PVC Coated Rigid Steel: 0.04 in (1 mm) thick coating. Per NEMA RN 1.
      c. GRC: Galvanized Rigid Steel Conduit: Per ANSI C 80 and UL 6.

2. Nonmetallic Conduit:
3. PVC: Rigid nonmetallic conduit, EPC-40 per NEMA TC 2 and UL 651.

2.8 LIGHTING

A. Indoor Lighting Fixtures:
1. Fixture Type: Hi Abuse Fixture, Linear Fluorescent 40 Watts, Lamp Quantity 2, 120 V. Length 49.38 inches, width 9.25 inches, depth 3.38 inches, white, cold weather.
2. Switching: Provide single-pole switch mounted adjacent to door to control lighting fixtures (standard).
3. Exit Signage: Exit signs shall be clearly marked. In the event of electrical power outage during use or occupancy in the press box, the exit signs will illuminate.
4. Illumination Level: 50 foot-candles (standard).

B. Outdoor Lighting Fixtures: High Abuse cold weather, linear fluorescent 40 Watt, Lamps, 120 Vac.
1. Size (LxWxD): 49.38 x 9.25 x 3.38 inches (1254 x 235 x 86 mm).
2. Fixture Type: Wall Pack, Cooper XTOR1A-WT-PC1, white with photo cell
3. Switching: Provide single-pole switch mounted adjacent to door to control lighting fixtures.
4. Switching: Provide photoelectric controller.

2.9 HVAC

A. Thru-wall Air Conditioning: Sized to meet Project requirements.

B. Louvers: Extruded Aluminum Louvers with Insect Screens. Sized to meet Project requirements.

C. Gravity Intake Damper with Insect Screen. Sized to meet Project requirements.
1. Galvanized.

2.10 ASSEMBLY

A. Shop assemble complete building.
1. Flanges between adjacent panels shall be factory bonded together with methyl methacrylate.
2. Seal exterior edges of adjacent panels with color matched silicon sealant.

B. Fit and bond appurtenances, formed separately, into openings cut in finished panel or integrally mold into panel. Bond attachments with glass fibers and resin from interior of panel.

C. Resin seal cut all drilled edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Check installed anchor bolts for accuracy. Verify that bearing surfaces are ready to receive the work.

E. Verify the rough-in of required mechanical and electrical services prior to placement of the structure.

3.2 PREPARATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Clean surfaces thoroughly prior to installation.

D. Commencement of installation constitutes acceptance of conditions.

3.3 INSTALLATION

A. Install composite building according to manufacturer's written instructions.

B. Install continuous neoprene gasket between perimeter anchoring flange and where panels rest on supporting structure.

C. Set booths plumb and aligned.

D. Fasten control booths securely.

E. Resin seal cut all drilled edges.

F. Repair damaged panels.

G. Connect electrical power service to power distribution system.

3.4 ADJUSTING

A. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

C. After completing installation, inspect exposed finishes and repair damaged finishes.

D. Protect installed buildings until completion of project.

E. Touch-up, repair or replace damaged items before Substantial Completion.

END OF SECTION 133423

SECTION 26 01 35

ELECTRICAL GENERAL

PART 1 GENERAL

1.01 SCOPE

A. This Division and the accompanying electrical drawings cover furnishing all labor, equipment and materials and performing all operations in connection with the installation of complete electrical systems as documented on plans and specifications.

B. There are many interfaces between the work involved with this Division and the work in other Divisions, particularly with Division 15. Be aware of the responsibilities at the interfaces. The exact locations of apparatus, fixtures, equipment and raceways shall be ascertained from all concerned and the work shall be laid out accordingly. In addition, coordinate with all equipment suppliers and other trades to verify the actual installation requirements prior to rough-ins.

C. The plans and specifications are considered cooperative and complimentary. Where one contradicts the other, notify the Architect/ Engineer for clarification prior to any installation.

D. All applicable portions of the General and Specific Conditions are included herein by reference.

1.02 DEFINITIONS

A. Install: Receive, store, place, fix in position, secure, anchor, etc., including necessary appurtenances and labor so the equipment or installation will function as specified and intended.

B. Furnish: Purchase and supply equipment and components, including shipping and receiving.

C. Provide: Furnish, install, connect, test, demonstrate and leave operational.

D. Wiring: Wire or cable installed in raceway with all required boxes, fittings, connectors, etc.

E. Work: Materials completely installed, including the labor involved.

F. Or approved equal: Equal in type, design, quality, appearance, etc. as determined by the Architect/Engineer.

G. Raceway: Galvanized rigid steel conduit (GRC), electrical metallic tubing (EMT), intermediate metal conduit (IMC), schedule 40 Polyvinyl Chloride (PVC), flexible steel (FLX), sheathed flexible steel (SLT), code gauge wireway (WW).

1.03 CODES AND REGULATIONS

A. All work shall comply with all local laws, ordinances and regulations applicable to the electrical and fire alarm/life safety system installation, NFPA, OSHA, ANSI, SBC, BOCA, UBC, municipal ordinances governing electrical work, and with the requirements of the 2020 National Electrical Code or latest edition approved by the local authority having jurisdiction.

B. Where different sections of any of the aforementioned codes and regulations, the specifications or the plans require different materials, methods of construction, or other requirements, the most restrictive or stringent shall govern. In any conflict between a general provision and a special provision, the special provision shall govern.

C. Obtain all permits and licenses, and pay all fees as required for execution of the Contract. Arrange for necessary inspections required by the Architect, city, county, state and other local authorities having jurisdiction and present certificates of approval to the Owner or his designated representative.

D. Under no circumstances will asbestos, or asbestos related materials, be allowed on this project.

E. Communicate with all required utility offices to meet utility schedules and regulations. Coordinate the local utility requirements with the requirements of these contract documents. Should conflicts arise, notify the Architect/Engineer immediately. Acquire services to avoid project delays. Conform to regulations of the local utility company with respect to metering, service entrance and service access.

1.04 SITE VISIT

A. All interested parties shall visit the site and thoroughly familiarize themselves with the local conditions and existing conditions which may affect the cost of the Work in advance of any project activity or submission of bids.

B. Where work under this Division requires extension, relocation, reconnection or modifications to the existing equipment or systems, the existing equipment or systems shall be restored to their original condition prior to completion of this Project.

C. No allowances will be made for lack of knowledge of job conditions which could reasonably be identified during site visit.

D. Verify the service entrance voltage and short circuit contribution with the serving power utility and provide written confirmation of same to the Architect prior to submitting shop drawings or ordering any materials for use in the building served. Provide service entrance equipment fully rated to interrupt the available fault current from the serving utility.

1.05 DRAWINGS AND SPECIFICATIONS

A. The Electrical Drawings are diagrammatic and are not intended to show the exact location of raceways, outlets, boxes, bends, sleeves, fire sealant, couplings or other such elements except where dimensions are noted. Provide all required offsets, extensions or pull boxes required for a fully coordinated and operational system.

B. The Drawings and Specifications shall both be considered as part of the Contract. Any work or material shown in one and omitted in the other, or which may fairly be implied by both or either, shall be provided in order to give a complete job.

C. Should conflicts exist between the Drawings and Specifications, notify the Architect/Engineer for clarification prior to installation.

D. Refer to the Architectural (Interiors), Structural and Mechanical plans, Civil, Kitchen and other project construction and shop drawings and details for dimensions and fit the work to conform to the details of building construction.

E. Review the drawings for door swings, cabinets, millwork, counters and other built-in equipment. Coordinate installation of the electrical equipment with structural systems and mechanical systems such that full maintenance access is provided.

F. The right is reserved to shift any switch, receptacle, ceiling outlet or other outlet a maximum of 10'-0" from its location as shown before it is permanently installed, without incurring additions to the Contract in time or cost. In addition, refer to the Architectural Drawings for exact location of devices and equipment.

G. All conduit and wiring shown on the Electrical Drawings shall be provided under this Division regardless of its function.

H. Review the drawings and specifications provided for other systems such as Elevator Equipment, Sound System, CATV, Computer, Landscape, etc., for additional work which may be required under this Division. Provide service to and make connections to all such equipment requiring electrical service.

I. Equipment configuration is based upon one manufacturer's product. Where the equipment selected by the Contractor for use on this Project differs from the configuration shown, the Contractor shall be responsible for coordinating space requirements, connection arrangements, interfaces with mechanical and plumbing equipment and all other affected trades and providing access for future maintenance and repair. Submit proposed revisions for approval by the Architect/Engineer.

1.06 EQUIPMENT CONNECTIONS

A. The horsepower, wattage (or amperes) of mechanical equipment indicated is the estimated requirement of equipment furnished under another Division. All wiring, protective devices and disconnect switches shall be of the voltage, size and ampacity required for the actual equipment installed, without increase or additional costs. In no case shall these items be of smaller capacity than permitted by National Electrical Code.

B. Coordinate with other trades and review the drawings of other divisions. Conform with UL Listing and nameplate requirements for equipment furnished. Such adjustments shall be subject to the approval of the Architect/Engineer.

C. Provide suitable overcurrent protection and disconnecting means in conformance with the requirements of the NEC, for all items or equipment utilized on the project no matter how, or by whom, furnished. However, duplication, or redundancy, is not required. Coordinate said requirements with equipment furnished and with applicable trades.

D. Branch circuits supplying control panels and other equipment master and local unit locations and quantities shall be coordinated at the submittal stage and provided under Division 16. Provide emergency power where required to accomplish emergency equipment operations in accordance with Division 15 requirements. All control wiring for plumbing and heating, ventilation and air conditioning systems shall be installed under Division 15. Review Division 15 specifications and shop drawings for control systems to assure system compatibility between equipment furnished under Division 16 and system wiring and controls furnished under Division 15.

E. Motor controllers shall be installed by Division 26 where automatic control of equipment is required, unless specified to be furnished as an integral part of packaged equipment. Power wiring to all motors and motor controllers and between motors and controllers shall be furnished under Division 26.

F. For each electrical connection required, provide pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire connectors, and other items required to complete splices and terminations of the necessary types. Cover splices or terminations with electrical insulation equivalent to insulation of conductors terminated.

1.07 ELECTRICAL OUTAGE SCHEDULING

A. Electrical work requiring interruption of electrical power which would adversely affect the Owner’s operation shall be done at times other than normal working hours. Coordinate with Owner to establish normal working hours for this facility.

1.08 STANDARDS FOR MATERIALS AND WORKMANSHIP

A. All material shall be new and shall bear the inspection label of Underwriter's Laboratories, Inc. (UL).

B. The published standards and requirements of the National Electrical Manufacturer's Association (NEMA), Underwriters' Laboratories (UL), Electrical Testing Laboratories (ETL), American National Standards Institute (ANSI), Institute of Electrical and Electronic Engineers (IEEE), Insulated Cable Engineers Association (ICEA), National Fire Protection Association (NFPA) and the American Society for Testing and Materials (ASTM) shall govern and apply where such have been established for the particular material in question.

C. Specified catalog numbers and trade or manufacturers names are intended to describe the material, devices, or apparatus desired for type, construction features, electrical characteristics, ratings, operating functions, style and quality. Similar materials of other manufacturers not less than specified quality, capacity or character may be substituted in conformity with the provisions of the General and Supplementary Conditions. Materials of the same type shall be the product of one manufacturer. Refer to Shop Drawing requirements.

D. Furnish all materials specified herein or indicated on the drawings.

E. All work shall be installed in a practical and workmanlike manner by competent workmen, skilled in their trade.

1.09 SHOP DRAWINGS

A. Provide complete electrical characteristics for all equipment. Submit for approval data of the materials and equipment to be incorporated into the work. Submittals shall include descriptive materials, catalog cuts, diagrams, performance characteristics, and charts published by the manufacturer indicating conformance to the specification and drawing requirements; model numbers alone will not be acceptable. Submittals shall be made by Specification section number, tabbed, within three ring binders, grouped and submitted in packages as indicated below. Submittals for lighting fixtures shall include full photometric data. Shop drawings shall be submitted for the following equipment and items suitably bound, and marked:

1. Package II:

    a. Section 26 2416 Panelboards

    b. Section 26 2200 600 Volt Transformers

2. Package III:

a. Section 26 5600 Lighting

B. Shop drawings and/or catalog data submittals on all items of equipment and materials shall be submitted in conformity with requirements of the General and Supplementary Conditions. Do not submit more than the required number of sets. Do not submit equipment or materials not requested in the Specifications.

C. All material lists and shop drawing submittals shall include a stamped indication by the Contractor signifying that the submittals have been previously reviewed for complete compliance with the Contract Documents, that all coordination required between trades prior to field installation has occurred and that the material being submitted is approved for installation. The stamped indication shall include the name of the contracting firm, the date of the review and the signature of the contractor. The Engineer will not review the shop drawing submittals without the contractor's stamped approval already on the shop drawings. The responsibility of complying with the Contract Documents will not be relieved by the Engineer's review, which requires 10 working days from the date the shop drawings are received by the Engineer.

D. All pricing is to be based upon the products, manufacturers, and processes described in the Contract Documents. Requests for approval of substitutions shall be written and delivered to the Architect's/Engineer's office in conformity with the provisions of the General and Supplemental Conditions. Do not submit any shop drawing or product data that does not conform with the contract documents.

E. Resubmittals, if necessary, shall be made as specified above. Resubmittals will highlight and indicate any and all revisions made thereto and will include the following text " Resubmittal #___", typed in a prominent location on the cover sheet.

F. The Contractor shall provide with the shop drawing submittal dimensioned layouts of all electrical rooms and spaces using the equipment he intends to furnish. Switchboard, panelboards, distribution panels, etc., will be rejected without dimensioned room layouts.

G. Samples of all materials proposed for use shall be presented to the Architect for his approval when requested.

H. Submittals shall be noted with any deviations, alterations or limitations of product from the specified materials. The product will be rejected upon failure to indicate this information. Any conflict or failure to perform comparably to the originally specified materials will result in product rejection. It will be the Contractor's responsibility to replace the alternate material or equipment with the originally specified one and to demolish, replace, repair and retest the equipment, including repair or replacement of any component of the building, finishes or other systems affected by said replacement, at no additional costs to the Owner.

1.10 SUPPORT FASTENER DEVICES

A. Anchors for post tensioned concrete applications shall be cast in place continuous or spot insert channel providing a safety factor of 3 in 3000 lb hard rock concrete.

B. Anchors for cast in place concrete shall be insert type expansion shields and bolts, lead shields and bolts or self-drilling expansion shields and bolts. Powder actuated pins of 1500 pound pull out strength may be utilized in concrete.

C. Anchors for wood construction shall be lag bolts or power-driven wood screws.

D. Anchors in hollow masonry shall be toggle bolts.

E. Anchors for steel attachment shall be machine screws, bolts, or beam clamps.

F. Equipment mounted to drywall construction shall be secured to power channel (13/16” x 1 5/8” minimum). Secure channel to a minimum of two (2) dry wall studs with drywall screws and washers.

1.11 SUPPORTS

A. Furnish and install under this contract all angle iron, channel iron, rods, threaded rod, supports or hangers required to install or mount all electrical equipment, material or related devices. Conduit shall not be supported from steel decking, roof decking, bridging, ceiling or ceiling support wires.

1.12 IDENTIFICATION

A. All equipment or devices specified in Division 16 shall be identified with an engraved plastic nameplate. Identification of flush equipment shall be on the inside of the cover. Surface equipment shall be identified on the outside. Plastic nameplates shall be multicolored laminated plastic with engraved lettering. Nameplates shall be provided as scheduled:480/277 volt normal power equipment shall be black faceplate/white core.

1. 480/277 volt normal power equipment shall be black faceplate/white core.

2. 480/277 volt emergency power equipment shall be red faceplate/white core.

3. 240/120 volt normal power equipment shall be white faceplate/black core.

4. 240/120 volt emergency power equipment shall be white faceplate/red core.

5. Computer power equipment (ie UPS, isolated ground, etc.) shall be range faceplate/white core.

B. Refer to Section 260553 Identification for Electrical Systems for lettering size and nameplate requirements.

1.13 AS-BUILT (RECORD) DRAWINGS

A. Maintain on the job site at all times during construction a set of "As-Built" mylar sepias with all changes during construction marked thereon. This set shall be utilized for no other purpose. Include any addenda, change orders, field orders, project sketches or "marked-up" drawing prints as may be generated on the job site to assist in recording the changes.

B. The "As-Built" sepias shall show all changes and deviations from the Contract Drawings including relocation of outlets, conduit and equipment. Record final dimensioned locations of switchboards, panelboards, transformers, disconnect switches, etc. Make sufficient measurements to locate all underground conduit. Show exact locations of underground cable and conduits, both interior and exterior, fully dimensioned from building column lines or permanent exterior structures. These drawings shall be available for reference at the time of final inspection.

C. At the completion of construction, the Contractor shall purchase a set of reproducibles from the Architect/Engineer at cost of printing and shipping. All changes noted above shall be incorporated thereon by the Contractor. The reproducible drawings, with one set of blueline prints thereof and the original sketches and marked-up "As-Built" prints shall be presented to the Owner.

1.14 MAINTENANCE AND INSTRUCTION MANUALS

A. Submit to the Architect/Engineer, upon completion of the work and prior to final inspection, copies of maintenance and instruction manuals for equipment provided as outlined below

B. Three sets of the following data are required:

1. Operating and maintenance instructions.

2. Spare parts list.

3. Copies of approved submittal data.

4. Copies of panelboard circuit directories reflecting all field changes.

5. Test reports of all tests performed. Certificates of inspection from the inspector services

6. Contact names and phone numbers for parts suppliers of submitted equipment.

C. Arrange each set of data in an orderly way and bind each set in a separate 3-ring hard-cover binder with appropriate label identifying the Project, Architect, Engineer, Contractor, Subcontractor and Date.

1.15 SUBMISSION OF DRAWINGS

A. Submission of Engineer's drawings for shop drawings and unaltered Engineer's drawings for "As-Built" will not be acceptable.

PART 2 PRODUCTS

2.01 SPARE PARTS AND ATTIC STOCK

A. Prior to final inspection, turn over to the Owner the following materials of the type and quantity specified. Material shall be new, in original shipping containers or cartons, of the same manufacture and type as installed on the Project. Obtain receipt for all materials turned over to the Owner.

1. Lamps

2. Fuses

3. Ballasts

2.02 COORDINATION

A. Before any piping, conduit, outlets, equipment or lighting fixtures are located in any area, coordinate the space requirements with all trades. Such shall be arranged so that space conditions will allow all trades to install their work and will also permit access for future maintenance and repair. Coordinate the installation of recessed electrical equipment with concealed ductwork, piping, insulation, structural appurtenances and wall thickness.

B. Piping, ductwork, conduit and equipment installed at variance with the above requirements shall be relocated and/or revised to conform with the above requirements without incurring additions to the Contract.

Coordination of space requirements with all trades shall be performed so that:

1. No piping or ductwork, other than electrical, shall be run within 42" of panelboard switchboards or transformers

2. No pipes or ducts that operate at a temperature in excess of 120 degrees F. shall be installed nearer than 3" to any electrical conductor.

C. Do not scale drawings. Obtain dimensions for layout of equipment from the Architectural drawings unless noted on the Electrical drawings.

2.03 PROTECTION OF MATERIALS

A. Refer to the general requirements section of the Specifications for storage, protection and handling requirements.

B. Provide dry, weathertight staging and storage for materials and equipment requiring protection from weather and moisture per manufacturer's recommendations. Install temporary lighting or heat sources to prevent moisture accumulation. Provide protection against direct sunlight, precipitation, wind, ice, fire or excessive heat. Store materials in original undamaged packaging with manufacturer's labels and seals intact. Containers which are broken, damaged or watermarked are not acceptable and are subject to rejection.

C. Materials and equipment will not be installed until the environmental conditions of the project are suitable to protect same per manufacturer's recommendations. Equipment or materials damaged or subjected to moisture, precipitation, direct sunlight, cold or heat are not acceptable and shall be removed from the project and replaced at no additional costs to the Owner.

D. All conduit and other openings shall be kept protected to prevent entry of foreign matter or construction debris. Fixtures, equipment, and apparatus shall be kept covered for protection against dirt, water, chemical or mechanical damage before and during construction.

E. The original finish, including shop coat of paint of fixtures, apparatus or equipment that has been damaged shall be restored without incurring additions to the Contract in time or price.

2.04 HOUSEKEEPING PADS

A. Provide 6" minimum height concrete pad, integral with floor, under all floor mounted electrical equipment or apparatus.

2.05 CUTTING AND PATCHING

A. The Contractor is responsible for all cutting and patching, including escutcheon plates where necessary, whether or not such cutting and patching is shown or indicated.

2.06 CLEANING AND PAINTING

A. Remove foreign materials, drywall compound, overspray, oil, dirt and grease from all raceway, fittings, supports, boxes, cabinets, pull boxes, panelboard trims and equipment to provide clean surfaces for painting. Remove surface oxidation and restore galvanized surfaces with cold process galvanizing compounds. Touchup marred or scratched surfaces of fixtures, panelboard and cabinet trims, motor control centers, switchboards, cabinets, and equipment enclosures with paint furnished by the equipment manufacturer specifically for that purpose.

B. Do not paint trim hinges, latches, clamps, locks, device covers or trim covers. Mask or remove such items prior to finishing.

C. Unless otherwise noted herein, all painting shall conform to the "Painting" section of the specifications.

D. Where plywood backboards are utilized to mount electrical or electronic equipment provided under Division 16, finish same with two (2) coats of light gray semi-gloss paint.

2.07 ACCESS TO ELECTRICAL ITEMS

A. Install all concealed electrical equipment, junction and pull boxes, apparatus, or devices so as to maintain access for maintenance, operations and replacement. Access doors or covers shall be provided where required by NEC or LAHJ and shall be installed in accordance with manufacturer's instructions. Refer to the Architect for approved types, means, methods and appearance. Locate each access unit accurately in relation to electrical work requiring access.

2.08 ELECTRICAL ROOMS AND CLOSETS

A. Manufacturer's equipment shall not be larger than that dimensioned, or scaled, on plans. Conflicts shall be brought to the attention of the Architect, for resolution prior to ordering equipment.

B. Clear working space in electric rooms and closets shall be no less than required by the N.E.C.

C. Submit for review, prior to construction or purchase of any equipment, scaled drawings of electrical rooms, closets, or spaces showing, in detail, planned installation locations of the equipment. These shall clearly show compliance with A and B above.

PART 3 EXECUTION

3.01 EQUIPMENT CONNECTIONS

A. Review all divisions of specifications, where equipment requiring electrical service is specified, to determine the complete scope of work under this division of the specifications. Provide electrical connections and service to all equipment specified elsewhere requiring such connections or service.

B. Connect all equipment requiring electrical connections, in accordance with the equipment manufacturer's requirements. Where equipment connections require specific locations, determine and coordinate same with submittals. Provide concealed service to central plant equipment locations and pads.

3.02 NAMEPLATES AND IDENTIFICATION

A. Provide and install nameplates for transformers, switchboards, switchgear, power and lighting panels, disconnect switches, time switches, pull boxes, junction boxes, fire alarm equipment, contactors, relays and other unit equipment. Nameplates shall be affixed with epoxy cement.

B. Install nameplates plumb and level.

3.03 EXCAVATION AND BACKFILLING

A. Provide and perform all excavation required to install conduit, ductbanks and manholes indicated on the drawings and/or specified. Trenches shall be of uniform width required with minimum 8" clearance on both sides. Remove and dispose of all materials not to be used for backfill. Maintain dry excavations for electrical work, by removing water. Grade areas to prevent surface water from entering excavation. Remove any accumulated water by pumping. Perform all excavation by open cut. Excavate with vertical-sided excavations where possible. Where necessary, provide sheeting and cross-bracing to sustain sides of excavations. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Establish requirements for trench shoring and bracing to comply with local codes and Amazon. No tunneling shall be permitted.

B. The bottom of all trenches and excavation shall be graded to provide uniform bearing surface for conduits or ductbanks on undisturbed soil at every point along entire length. Tamp over excavation with specified backfill materials. Remove unstable materials unsuitable for supporting equipment or installation and replace with specified materials for a minimum of twelve (12) inches below invert of equipment or installation.

C. Specified materials shall be utilized for backfilling, in not more than six (6) inch layers and tamped until the installation has cover of not less than the adjacent grade and not more than two (2) inches above same. Remove sheeting and cross-bracing during backfilling wherever such removal would not endanger the work or other property. Equalize backfilling operation to avoid shifting of materials and equipment installed. Compaction of backfill materials shall be at least equal to

surrounding undisturbed material. Backfill trenches with concrete where excavations pass within 18" of footings or other utility lines. Do not settle backfill with water. Conform to compaction requirements and methods specified elsewhere.

3.04 TESTS AND CERTIFICATIONS

A. Upon completion of the electrical work and prior to final inspection, conduct an operating test in the presence of the Owner and the Architect/Engineer or his designated representative.

B. The installation shall be demonstrated to operate in accordance with the Contract Documents. Any material or workmanship which does not meet with the approval of the Architect/Engineer shall be removed, repaired or replaced as directed without incurring additions to the Contract in time or cost. All electrical systems shall be tested for compliance with the specifications.

C. Furnish all instructions, tools, test equipment and personnel required for the test. Have sufficient tools and personnel available to remove equipment covers, coverplates, etc., as required for review of internal wiring and proper inspection. Provide hand tools, flashlights, ladders, outlet testers, VOM, meters and keys required to access and observe system operation and characteristics. Turn circuits on and off as directed and demonstrate operation of equipment as directed.

D. Contractor shall test all wiring and connections for continuity and grounds by megger testing. Upon indication of defective insulation, Contractor shall remove and replace the defective conductor and demonstrate by testing that the new conductor is acceptable. Record feeder load currents and line voltages measured at each transformer, switchboard and panelboard after installation of all equipment and lighting. Adjust transformer taps as required to provide optimum voltage levels. Adjust single phase load connections to balance feeder load and document on as-built drawings. Provide the Owner with full documentation of all testing for future reference.

E. Refer to the individual specification sections and the electrical systems testing section of the specifications for specific testing requirements.

F. The authorized manufacturer's service representative shall review systems and equipment for correct operation, conformance with specification requirements and manufacturer's requirements and submit certification indicating above mentioned conformances for the following systems:

1. Life Safety System

2. Emergency Generator Set

3. Automatic Transfer Switches

4. Interfaces to Mechanical & Building Systems

3.05 DEMONSTRATION AND INSTRUCTION

A. Present to the Owner and the Architect/Engineer or his designated representative a physical demonstration and oral instructions for proper operation and maintenance of each of the electrical equipment and systems installed. Authorized manufacturer's representatives familiar with the specified equipment shall conduct training for the following systems:

1. Life Safety System

2. Interfaces to Mechanical & Building systems

3. Motor Control Center

4. Switchboards

3.06 TEMPORARY WIRING

A. Provide a temporary electrical lighting and power distribution system of adequate size to properly serve the construction requirements, including adequate feeder sizes to prevent excessive voltage drop. Temporary work to be installed in accordance with the National Electrical Code, Article 305, and as required by OSHA or applicable local safety codes, rules and regulations.

3.07 WARRANTY

A. All systems and components shall be provided with a two-year warranty from the time of final acceptance. The warranty shall cover all defects in materials, design and workmanship. During this warranty period, all defects in materials and workmanship shall be corrected without incurring additions to the Contract. The correction shall include removing the defective part(s), replacing and installing the new parts (including shipping and handling), all required cutting, patching, repainting, or other work involved, including repair or restoration of any damaged sections or parts of the premises resulting from any fault included in the warranty, entirely at the expense of the Contractor.

B. In addition to this general warranty, present to the Architect any other guarantees or warranties from equipment or system manufacturers. These supplemental guarantees or warranties shall not invalidate the general warranty.

END OF SECTION 26 01 35

SECTION 26 05 02

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

B. Summary of work:

The project consists of electrical work for a new sanitary sewer lift station and force main as shown on the drawings. Major elements of the work include, but are not limited to the following:

1. Provide, install, and test one (1) new 480/277V, 3Ph Switchboard (SWBD-1)

2. Provide, install, and test one (1) new 450kW diesel Generator. Diesel generator shall include 72-hr rated sub-base fuel tank, weather protection enclosure, electrical connections for block heater and battery charger.

3. Provide, install, and test various standalone adjustable frequency drives, Control Panels, Starters as shown on the drawings.

4. Provide, install, and test various electrical components, such as dry-type transformers, panelboards, etc. as shown on the drawings.

5. Provide and install new site lighting around process equipment as shown on the design drawings.

6. Provide, install and test grounding system shown on drawings.

7. Provide and install a complete electrical system to provide power to the new odor control system, in ground water well, and eye wash station.

8. Provide and install electrical raceways shown on drawings.

1.2 ACTION SUBMITTALS

A. Provide Data For:

1. Electrical service components.

2. Internet service components.

3. Nameplates, signs, and labels.

B. Provide preliminary submittal for sequence of construction 14 days in advance of coordination meeting. Preliminary submittal shall include items listed in special project requirements.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.

2. National Electrical Manufacturers Association (NEMA):

a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).

b. Z535.4, Product Safety Signs and Labels.

3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

4. Underwriters Laboratories, Inc. (UL).

1.4 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

PART 2 PRODUCTS

2.1 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the site ambient temperature range.

2.2 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with, light gray color finish as approved by Owner.

2.3 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws: Stainless steel.

C. Color: White, engraved to a black core.

D. Letter Height:

1. Pushbuttons/Selector Switches: 1/8 inch.

2. Other electrical equipment: 1/4 inch.

2.4 SIGNS AND LABELS

A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.1 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other

surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.2 ANCHORING AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements.

3.3 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:

1. Analog control circuits from devices in same general area to same destination.

a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.

b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.

c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.

d. Raceways: shall be sized per General Circuit and Raceway Schedule and do not exceed 40 percent fill or National Electrical Code requirements.

e. Changes shall be documented on Record Drawings.

2. Discrete control circuits from devices in the same general area to the same destination.

a. No power or analog control circuits shall be combined in same conduit with discrete circuits.

b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.

c. Raceways shall be sized per the General Circuit and Raceway Schedule and do not exceed 40 percent fill or National Electrical Code requirements.

d. Changes shall be documented on Record Drawings.

3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).

a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.

b. Receptacle Circuits, 120-Volt Only: Combine no more than three circuits to a single raceway. Provide a separate neutral conductor for each circuit. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.

c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.4 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs:

1. Field mark Switchgear, switchboards, motor control centers, and panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.

2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 74, Arc Flash Study as basis for warning signs.

B. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.

2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.

3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.

4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.5 LOAD BALANCE

A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.

B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.

C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.6 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming. Includes all electrical gear and cabinets.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.

2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.7 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

B. When equipment intended for indoor installation is installed at Contractor’s convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION 26 05 02

SECTION 26 05 19

600 VOLT ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Armored cable, Type AC.
4. Variable Frequency Drive Cable.
5. Tray cable, Type TC, TC-ER.
6. Connectors and splices.

B. Related Requirements:

1. Section 26 05 23 "Control and Instrumentation Conductors and Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.2 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFD: Variable-frequency drive.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency and manufacturer's authorized service representative.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on- site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.0 PRODUCT SELECTION

A. Conductors and cables shall be furnished in accordance with the project "Conduit Schedule" and/or as shown on the contract drawings. Wire and cable part numbers shown on the contract drawings take precedence over the “Conduit Schedule”. In the absence of the aforementioned wire and cable list, and where a required conductor or cable is not specified on the contract drawings, conductors and cables shall be furnished in accordance with the following paragraphs of this specification.

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Okonite Company
2. Service Wire Co.
3. American Insulated Wire Corp.; a Leviton Company.
4. General Cable Corporation.
5. Houston Wire & Cable Company.
6. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 ASTM B496 for stranded conductors.

E. Conductor Insulation:

1. Conductor Insulation, No. 10 AWG and smaller: Comply with NEMA WC 70 for Type THHN-THWN.

    a. 600V rated, minimum.
    b. 90ºC rated dry or 75 ºC rated wet.

2. Conductor Insulation, No. 10 AWG and smaller: Comply with NEMA WC 70 for Types XHHW-2 and SO.

    a. 600V rated, minimum.
    b. 90ºC rated wet or dry.
    c. SO cable: Yellow jacket.

3. Conductor Insulation, No. 8 AWG and larger: Comply with NEMA WC 70 for Types [THW] THHN-THWN-2, XHHW-2 [UF] [USE] and SO.

    a. 600V rated, minimum.
    b. 90ºC rated wet or dry.
    c. SO cable: Yellow jacket.

4. Multi-conductor Cable: Comply with NEMA WC 70 for [armored cable, Type AC] metal-clad cable, Type MC with aluminum sleath, tray cable, Type TC, [mineral- insulated, metal-sheathed cable, Type MI] [nonmetallic- sheathed cable, Type NM] and Type SO [and] [Type USE] with ground wire.
5. Type RHH and Type RHW-2: Comply with UL 44.
6. Type USE-2 and Type SE: Comply with UL 854.
7. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
8. Type THHN and Type THWN-2: Comply with UL 83.
9. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
10. Type UF: Comply with UL 83 and UL 493.

11. Type XHHW-2: Comply with UL 44.

F. Shield:

1. Type TC-ER: Cable designed for use with VFDs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Houston Wire & Cable Company.
4. Southwire Company.
5. Okonite Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel or Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.3 ARMORED CABLE, TYPE AC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in an overall metallic sheath.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Houston Wire & Cable Company.
4. Southwire Company.
5. Okonite Company

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Comply with UL 4.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit and multi-circuit with color-coded conductors.

E. Conductors: Copper, complying with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation: Type THHN/THWN-2. Comply with UL 83.

H. Armor: Steel or Aluminum, interlocked.

2.4 VARIABLE FREQUENCY DRIVE CABLE

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. LAPP OLFLEX
2. Belden, Inc.
3. General Cable Corporation.
4. Houston Wire & Cable Company.
5. Southwire Company.

B. Conductors: Comply with ASTM B3, B8, B33. Stranded tinned copper.

C. Conductor Insulation: Type XLPE (XHHW-2).

1. 600V/2000V rated.
2. 90ºC rated wet or dry.
3. Tray cable type, TC-ER.

D. Ground Conductor: Three bare copper conductors with minimum circular mil area equivalent to one circuit conductor.

E. Shielding: 100% coverage triple layer foil tape, 85% coverage tinned copper braid.

F. Jacket: PVC, suitable for 90 ºC.

G. The cable installed between the VFD and the local disconnect switch shall include a shielded, stranded, tinned copper signal pair for monitoring of the disconnect auxiliary contact. Exceptions will be made for larger cable sizes where an integral signal pair is not an option.

2.5 TRAY CABLE, TYPE TC

A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. LAPP
2. Belden, Inc.
3. Okonite
4. General Cable Corporation.
5. Houston Wire & Cable Company.
6. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Comply with UL 1277.
4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation: Type XHHW-2. Comply with UL 44.

G. Shield: Metallic.

2.6 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Polaris.
2. AFC Cable Systems, Inc.
3. Hubbell Power Systems, Inc.
4. O-Z/Gedney; EGS Electrical Group LLC.
5. 3M; Electrical Products Division.
6. Tyco Electronics Corp.
7. FCI, Burndy.
8. Thomas and Betts.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: Two hole with long barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.0 CABLE AND CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; minimum No. 12 AWG; stranded for No. 12 AWG and larger.

B. Branch Circuits:

1. Copper; minimum No. 12 AWG; stranded for No. 12 AWG and larger.

C. VFD Output Circuits Cable: Type TC-ER Shielded Variable Frequency Drive Cable.

3.1 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THWN-2, single conductors in raceway or multi- conductor in cable tray.

B. Feeders to MCC and other 480V distribution equipment. Type THWN-2, single conductors in raceway or multi-conductor in cable tray.

C. Feeders (to equipment other than 480V distribution equipment) Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, THHN-THWN-2, single or multi- conductor in conduit. Concealment of conductors or cable in concrete slabs, below slab-on- grade, and underground, is not permitted unless specifically indicated on the contract drawings.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, THHN- THWN-2, single or multi-conductor in conduit or tubing.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN- THWN, THHN-THWN-2, single or multi-conductor in conduit. Concealment of conductors or cable in concrete slabs, below slab-on-grade, and underground, is not permitted unless specifically indicated on the contract drawings.

3.2 INSTALLATION, GENERAL

A. Concealment of cables in conductors in finished walls, ceilings, floors, concrete slabs, below slab-on-grade, and underground is not permitted unless specifically indicated on the contract drawings.

B. Complete raceway installation between conductor origin and destination termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Do not exceed manufacturers recommended maximum bending radii.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems"

H. For cable entry at motors, disconnect switches, terminal and junction boxes, electrical panels and enclosures, provide adequately sized cable glands suitable for the installation environment.

1. Provide metallic cable glands in accordance with the following requirements:

a. 316L Stainless Steel in damp/wet/washdown production environments. Cable glands with non-metallic sealing components (eg. Roxtec seals), are acceptable.
b. Nickel plated brass in dry production environments. Cable glands with non- metallic sealing components (eg. Roxtec seals), are acceptable.

2. Non-metallic cable glands are not permitted in production environments.

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque- tightening values, using a calibrated torque wrench (calibration date within 12 months of use). If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

1. Compression Lugs: All feeder connections shall be made using compression two hole, long barrel design constructed of one piece, seamless high- conductivity copper.
2. Motor Connections: All motor connections shall be made using color-keyed motor pigtail connector, with female end on the motor and sealant to protect connection from moisture and dirt. Polaris Grey multi-cable connector blocks are preferred. Split bolt connectors are acceptable and it is preferred that they are wrapped with Vulko-Wrap 50mil insulating tape. Pressure (spring) connectors are not permitted.
3. All 120Vac and higher power connections, except motor control center and panelboard or switchboard circuit breaker connections, shall use stud terminals with non-insulated ring tongue compression connectors.
4. Pressure (Spring) Connectors may be used in lighting fixtures or in an immediately adjacent box. Connectors shall use a three piece ratchet spring construction.

B. Make splices and terminations that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Splices are allowed only in lighting circuits and motors that are customarily fabricated with potted pigtails.

    a. All splices made to conductors larger than No. 8 AWG shall be made by means of compression connectors.
    b. Splices shall be made in a conduit outlet box or device box. If more than twelve conductors, including the ground, need to be joined at a given location, use a terminal box rather than splices.

C. Spare conductors: seal with end cap.

D. Wiring at Junction and Device Boxes: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

E. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

F. Variable Frequency Drive Cable Shield: Shielded VFD cable drain wire and braided shield shall be combined, insulated (tape or heat shrink tubing), and terminated at ground terminals of VFD's in MCC cubicles, Motor Terminal Boxes, and isolated terminal in local Motor Disconnect Switches. Contractor shall provide an isolated terminal block for the shield terminations at intermediate termination points (eg. local disconnect switch) if isolated terminal blocks have not been provided by the equipment supplier. A small opening shall be made in the braid shield where the cable jacket is cut back, in order to extract the conductors from the braid. Provide connectors as necessary to make the terminations. Reference the Belden "Unarmored Variable Frequency Drive (VFD) Cable Termination Guide."

3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor, ceiling, and wall assemblies to restore original fire-resistance rating of assembly.

1. Firestopping shall be provided per the firestopping details shown on the contract drawings, utilizing Hilti firestopping products, installed in accordance with the manufacturers requirements.
2. In the absence of firestopping drawing details on the contract drawings, provide firestopping utilizing Hilti firestopping products, installed in accordance with the manufacturers requirements.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance, branch, and feeder conductors for compliance with requirements.

2. Perform each of the following visual inspections and electrical tests:

   a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the contract drawings.
   b. Test bolted connections for high resistance using one of the following, and provide a report on the results:

      1) Low-resistance ohmmeter.
      2) Calibrated torque wrench.
      3) Infrared scanning.

   c. Inspect compression-applied connectors for correct cable match and indentation.
   d. Inspect for correct identification.
   e. Inspect cable jacket and condition.
   f. Perform insulation-resistance test on each conductor to ground and adjacent conductors. Apply a potential of 500-V dc for up to 300-V rated cable and 1000- V dc for 600-V rated cable for a one-minute duration. Minimum acceptable resistance = 100Mohm.
   g. Perform continuity test on each conductor and cable.
   h. Confirm uniform resistance of parallel conductors.
   i. Verify voltage at MCC's, power distribution panels, and utilization equipment, including each motor to ensure voltage drop is within specification. All tests shall be performed in compliance with the personnel electrical safety requirements of the site.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct any deficiencies determined during the scan.

   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies all scans performed and that describes scanning results. Include notation of deficiencies detected, corrective action taken, and observations after corrective action.

B. End-to-end cabling will be considered defective if the entire cable does not pass tests and inspections.

C. Prepare written test and inspection reports to record the following:

1. Date.
2. Operator name.
3. Test equipment manufacturer, model and serial number, calibration date, and test procedures used.
4. Cable or conductor tag and associated equipment number.
5. Test results that comply with requirements.
6. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Field Quality Control Reports: Prepare test and inspection reports and submit an electronic copy (PDF format) to the Owner upon completion.

1. In addition to the reports referenced in the previous paragraphs of this section, the following test reports shall be provided:

a. Insulation Resistance (Megger) Test Report: indicate insulation resistance for each conductor phase-to-phase, phase-to-neutral, and each phase-to-ground, the test voltage, and meter manufacturer, model, serial number, and date of last calibration.
b. Torque Log: indicate the “design torque,” “actual torque,” “torque wrench tool number,” “calibration date,” and the individual performing the work for each conductor.
c. Voltage Verification: indicate rotation (CW or CCW) if test performed at a motor; indicate voltage values for each phase-to-phase and each phase-to- ground, meter manufacturer, model, serial number, and date of last calibration.

E. Remove and replace malfunctioning cables and conductors and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 23

CONTROL AND INSTRUMENTATION CONDUCTORS AND CABLES

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:
   1. Control and instrument signal cabling, AC/DC, 24V and below.
   2. Discrete control-circuit conductors, 120VAC/DC and below.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. Conductors and cables shall be furnished in accordance with the project "Conduit Schedule," and/or as shown on the contract drawings. Wire and cable part numbers shown on the contract drawings take precedence over the “Conduit Schedule.” In the absence of the aforementioned wire and cable list, and where a required conductor or cable is not specified on the contract drawings, conductors and cables shall be furnished in accordance with the following paragraphs of this specification.

2.2 PERFORMANCE REQUIREMENTS

A. RoHS compliant

2.3 CONTROL AND INSTRAMENT SIGNAL CABLE

A. Instrumentation Signal Paired Cable:
   1. Single and Multi-Pair, twisted, individually and overall shielded, 16AWG stranded tinned copper conductors.
   2. Type TC-ER per UL1277
   3. XLP Insulation
   4. PVC Jacket
   5. Shielding: Overall shield (100% coverage) with individually shielded pairs with separate drain wire for each pair.
   6. Manufacturers:
      a. LAPP
      b. Belden

B. Control-Circuit Paired Cable:
   1. Single and Multi-Pair, 14AWG stranded tinned copper conductors.
   2. Type TC-ER per UL1277
   3. PVC Insulation
   4. Thermoplastic Polymer Jacket
   5. Manufacturers:
      a. LAPP
      b. Belden

C. Cordsets: Shielded cable with premolded connector on one or both ends
   1. Cordsets shall be of sufficient length such that no intermediate terminations are required between the equipment/instrument and the termination points shown in the contract drawings
   2. Polyurethane(PUR) Jacket.
   3. Connectors:
      a. Connector type shall be suitable for connection to instruments or as indicated on the contract drawings.
      b. M12 connectors shall be IP67 rated; Polyurethane(PUR) molded body; Locking: brass, nickel plated; Contacts: gold-plated; Shielded connection cable
   4. Manufacturers:

a. IFM
b. Turck
c. Allen Bradley

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. General Requirements for Cabling:
1. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated terminals and devices/equipment.
a. 22 AWG and below shall be terminated with appropriate ferrules.

2. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.

3. Cables serving a common system may be grouped in a common raceway or cable tray. Install 24V discrete control and instrumentation wiring and cable in separate raceway or cable tray from power wiring and 120VAC discrete control wiring. Do not group conductors from different systems or different voltages.

4. Secure and support cables at intervals not exceeding 30 inches (760 mm).

5. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.

7. Pulling Cable: Comply manufacturer’s recommendations.

8. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.

9. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

10. For cable entry at motors, disconnect switches, terminal and junction boxes, electrical panels and enclosures, provide adequately sized cable glands suitable for

the installation environment.

a. Provide metallic cable glands in accordance with the following requirements:
    1) 316L Stainless Steel in damp/wet/washdown production environments. Cable glands with non-metallic sealing components (eg. Roxtec seals), are acceptable.
    2) Nickel plated brass in dry production environments. Cable glands with non-metallic sealing components (eg. Roxtec seals), are acceptable.
b. Non-metallic cable glands are not permitted in production environments.
    1) Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Open-Cable Installation:
1. Cables Installed Outside of a Raceway Must:
    a. Jacket material must be suitable for exposure.
    b. Provide proper strain relief.
    c. Enter conduit or box with approved fittings.
    d. Routed to avoid mechanical binding or abrasion.
    e. Routed to minimize exposure outside raceway.
    f. Routed as to avoid EMI exposure.
2. Cables Permitted outside of a Raceway
    a. Potted cables from control devices and instrumentation
    b. Micro and Mini quick disconnects cables
    c. Type TC-ER cable
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
4. Load Cell Cables
    a. Cables supplied with load cells shall not be cut.
    b. Cables shall be route cable to avoid mechanical binding or abrasion.
    c. Cables shall be route cable to avoid EMI exposure
5. Servo Cables
    a. Cables shall not be cut without prior written Owner approval.
    b. Excessive cable length may cause problems with EMI noise. Cables shall be provided with minimal excess length
    c. Separation from EMI Sources:
        1) Data/communications cables and instrument signal cables shall not be routed in raceways with 120 VAC and greater power and control conductors

3.3 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
1. 14 AWG. 16AWG and 18AWG may be permitted with prior written approval by the Owner.

3.4 GROUNDING

A. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
B. Shields on instrument pairs shall only be grounded on one end. The grounded end shall be in the control panel unless specified otherwise. Shields on the device end shall be cut and insulated with tape.

3.5 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
B. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
C. Identify each spare conductor at each end with identity number and location of the other end of the conductor, and identify as a spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. After cable and conductor installation, and before circuitry has been energized, perform the following Tests and Inspections:
    1. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components to confirm the installation is in accordance with the contract documents.
    2. Perform point-to-point continuity test for all installed conductors.
    3. Document data for each measurement.
C. End-to-end cabling will be considered defective if the entire cable does not pass tests and inspections.
D. Remove and replace defective cables and retest as specified above.
E. Field Quality Control Reports: Prepare test and inspection reports and submit an electronic copy (PDF format) to the Owner upon completion.

END OF SECTION 26 05 23

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1. Overhead-lines grounding.
2. Underground distribution grounding.
3. Common ground bonding with lightning protection system.

1.3 SUBMITTALS

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

B. Other Informational Submittals: Record drawings showing dimensioned locations of grounding features specified in Part 3 "Field Quality Control", including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. Grounding for sensitive electronic equipment.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Include the following in emergency, operation, and maintenance manuals:

1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NETA Maintenance Testing Specification.

a. Tests shall be to determine if ground resistance or impedance values remain below specified maximums, and instructions shall recommend corrective

action if they do not.
b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Tinned Conductors: ASTM B 33.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
3. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, copper.
2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.

D. Grounding Bus: Rectangular bars of annealed copper, 1/2 by 2 inches (13 by 50 mm) in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

A. Manufacturers: Subject to compliance with requirement, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds
2. Thomas & Betts
3. FCI, Burndy Electrical
4. Erico International Corporation
5. OZ/Gedney

B. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4-inch by 10 feet (19-mm by 3 m).

B. Plate Electrodes: Copper-clad, 1/10-inch (2.5-mm) thick, 24 inches by 24 inches (610 mm by 610 mm).

C. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts. Permitted only with written approval from owner.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install THWN-2 copper conductor, No. 2 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1-inch (25-mm), minimum, from wall; 100 inches (2500-mm) above finished floor, unless otherwise indicated.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING OVERHEAD LINES

A. Comply with IEEE C2 grounding requirements.

B. Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 25 ohms.

C. Drive ground rods until tops are 12 inches (300 mm) below finished grade in undisturbed earth.

D. Lightning Arrester Grounding Conductors: Separate from other grounding conductors.

E. Secondary Neutral and Transformer Enclosure: Interconnect and connect to grounding conductor.

F. Protect grounding conductors running on surface of wood poles with molding extended from grade level up to and through communication service and transformer spaces.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No 2 AWG THWN-2, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with pad-mounted substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.4 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders, branch and control circuits.

1. Use of raceway as equipment grounding conductor is not permitted.
2. Install individual grounding conductor for each circuit. Daisy chaining grounding conductors is not permitted, except in lighting and receptacle circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.

C. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

D. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

E. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

F. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated

equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

G. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

H. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

I. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

J. Instrumentation: Install a separate, No. 16 AWG minimum, insulated grounding conductor in raceway from control panel ground terminal to each field instrument.

3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.

C. Ground Rods: Drive rods until tops are 6 inches (150 mm) below finished floor or final grade, unless otherwise indicated.

1. Install ground rods spaced at least one-rod length from each other and at least the

same distance from other grounding electrodes and connect to service grounding electrode.

2. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems" and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test wells for each service, unless otherwise indicated. Install test well at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug- type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at equal distances not less than 60 feet (18

m) and not more than 80 feet (24 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column and indicated item, extending around the perimeter of building, area or item indicated.

1. Install tinned-copper conductor not less than No.4/0 AWG for ground ring and 2/0 AWG for taps to building steel.
2. Bury ground ring not less than 24 inches (600 mm) from building foundation.

J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 4 AWG or #4 (1/2 inch) steel reinforcing bars.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 CONNECTIONS

A. Make connections in such a manner to minimize the possibility of galvanic action or electrolysis. Select connectors, connection hardware, conductors and connection method so metal in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to assure high conductivity and make contact points closer in order of galvanic series.
2. Make connections with clean bare metal at points of contact.
3. Coat and seal connections involving dissimilar metals with inert material such as red lead paint to prevent future penetration of moisture.

B. Welded Connections: Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

A. Where metallic raceways terminate at metallic housings use conduit hub and locknut assembly to form a positive ground between raceway and enclosure. Refer to Division 26 Section “Raceway and Boxes for Electrical Systems.”

B. Tighten grounding and bonding connectors and terminals, including screws and bolts. Where manufacturer’s torque requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL486B.

C. Compression Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connector. Provide embossing die code or other standard

method to make a visible indication that a connector has been adequately compressed on the grounding conductor.

D. Moisture Protection: Where insulated grounding conductors are connected to ground rods or ground bus, insulate the entire area of the connection and seal against moisture penetration of the insulation and conductor.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 5 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 5 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 5 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner’s Representative promptly and include recommendations to reduce ground

resistance.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

A. Section Includes:
1. Slotted tented angle support systems.
2. Post mount support systems.
3. Aluminum slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
a. Slotted support systems, hardware, and accessories.
b. Slotted tented angle
c. Post mounts.
d. Clamps.
e. Hangers.
f. Sockets.
g. Eye nuts.
h. Fasteners.
i. Anchors.
j. Saddles.
k. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Slotted tented angle support systems.
4. Post mount support systems.
5. Equipment supports.
6. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Ductwork, piping, fittings, and supports.
3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Luminaires.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Projectors.

B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

A. Products and installation means and methods specified on the contract drawings take precedence over this specification section.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
1. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.3 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

B. Conduit and Cable Support Devices: Steel, Stainless or galvanized and malleable-iron

hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of zinc plated malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Post mount systems: 2" schedule 40 stainless steel pipe, with weld sealed cap and mounting plate. Manufactured by Rocket Rack, or equal.

F. Dura-Blok rooftop supports with zinc plated attachment hardware and rooftop membrane protection pads.

G. Tented angle: fabricated from 2"x2"x1/4" angle, slotted, and suitable for use with 3/8" or ½" rod, as specified. Stainless steel or galvanized steel. Manufactured by Rocket Rack or equal.

H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        1) Cooper B-Line
        2) Empire Tool and Manufacturing Co.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool and Works, Inc.
        5) MKT Fastening, LLC.

2. Concrete Inserts: Steel and malleable-iron, or stainless steel, units similar to MSS Type 18 units and comply with MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Smooth galvanized, smooth stainless steel, threaded steel, or manufacturer coated all thread rod with FDA certified coating, Rocket Rod or equivalent.

7. Flat stock, stainless steel or galvanized steel.

2.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 051200 "Structural Steel" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1 – Good Workmanship in Electrical Construction.
2. NECA 101 – Standard for Installing Steel Conduit.
3. NECA 102 – Standard for Installing Aluminum Rigid Metal Conduit.
4. NECA 105 - Standard for Installing Metal Cable Tray.
5. NECA 111 – Standard for Installing Nonmetallic Raceway.

B. Products used in Indoor Pre-Packaging, Process, Outdoor, Electrical and MCC Rooms in Production Areas, and all other Industrial Environments shall be stainless steel, including fasteners, screws, nuts, bolts, etc.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems"

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways Cable Tray: Space supports for EMT, IMC, and RMC a maximum of 10 feet on center, unless otherwise indicated on the contract drawings. Minimum rod size shall be 3/8 inch (9.5 mm) in diameter. Cable Tray shall be supported at maximum distance between intervals not to exceed the distance in accordance with the manufacturer’s installation instructions for the specific cable tray

E. Cable tray support systems shall utilize slotted tented angle and flat stock (for wall mounting) in production environments (this includes Process, Pre-Packaging, and Packaging areas).

F. Hanger Rods:
1. Maximum of 3 inches(76 mm) of exposed threads permitted for leveling.
2. Coated all thread rod shall not be installed above processing and packaging areas where there is exposed product and raw material.
3. Coated all thread rod shall be installed at high-bay/ceiling level only, where risk of damage to the coating is minimal.
4. Hanger Rod material construction shall comply with 3.1.C & 3.2.D above

G. Multiple Raceways or Cables: Install Rocket Rack (or approved equivalent) supports fabricated with steel that corresponds to the hygiene requirements as mentioned in 3.1 above, sized so capacity can be increased by at least 10 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

H. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings only.

I. Roof supports for cable tray and conduit: Install post mount support system or rack system utilizing Dura- Blok base. Provide a roof membrane protection pad under each post base and Dura-Blok base. Supports shall not be anchored to the roof in a manner than punctures the roof membrane.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

F. Provide lock washers on all nuts.

G. In Process and Pre-Packaging Production environments, enclosures, raceway supports, and cable tray which are equipment, wall or surface mounted, shall maintain clearance on all sides to enable cleaning, as specified below:
1. Wall or surface mounted cable tray and conduit support rack: maintain minimum 4” of clearance on all sides
2. Cable tray and conduit support racks mounted on equipment, including skids: maintain minimum of 2” clearance on all sides.
3. Individually mounted conduits: maintain minimum 1” clearance on all sides.
4. Enclosures: maintain minimum of 4” of clearance on all sides

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 051200 "Structural Steel" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

D. Structural Tubing: Gasket, sleeve or drill and tap bolted attachments.

E. Where supports are welded or bolted to equipment and equipment support structures, or metallic building structures, use like materials. Use galvanized steel bracket for mild or galvanized steel. Use stainless steel brackets for stainless steel.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 3/4 inches (19.5 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Comply with requirements of Division 09 Section “Painting” for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

3.6 CAULKING

A. Comply with requirements of Division 07 Section “Sanitary Joint Sealers” for caulking of penetrations and junctions of dissimilar materials.
1. Perimeters of all wall anchorage plates or similar steel to masonry.
2. Fasteners, bolts, anchors, etc., to filled or hollow concrete block.

END OF SECTION 26 05 29

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes and enclosures for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Conduit is to be used above and below ground on this project.

2.2 BOXES AND ENCLOSURES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Thomas & Betts Corporation.
10. Walker Systems, Inc.; Wiremold Company (The).
11. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Cast-Metal Outlet and Device Boxes: UL 514A, NEMA FB 1, ferrous alloy, Type FD, with gasketed cover. UL 886, ferrous alloy, Type FD for hazardous areas.

C. Small Sheet Metal Pull and Junction Boxes: UL 50, NEMA 250, Type 12, screw or clamp cover, finished inside and out with manufacturer’s standard enamel.

D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

E. Hinged-Cover Enclosures: UL 50, NEMA 250, Type 12, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
4. Change from RNC, Type EPC-40-PVC to rigid steel conduit, except use stainless steel conduit in damp or wet interior locations, before rising above the floor for immediate transition to equipment or tray.

B. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints.

Follow compound manufacturer's written instructions.

C. Raceway Termination at Metal Enclosures: Use a malleable iron, threaded conduit hub with insulated throat, recessed gasket and locknut that provides a positive ground between raceway and enclosure and a vibration resistant connection. Grounding requirements are specified in Division 26 Section “Grounding and Bonding for Electrical Systems.”

D. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

E. Clean burrs and swab raceways of foreign material and moisture before installing conductors.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Comply with requirements in Division 26 Section “Sleeves and Sleeve Seals for Electrical Raceways and Cabling.”

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and enclosures are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

3.4 IDENTIFICTION

A. Identify raceway, wireway, boxes and enclosures as specified in Division 26 Section “Identification for Electrical Systems.”

END OF SECTION 26 05 33

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Conduit, ducts, and duct accessories for concrete-encased duct banks, and single duct runs.
2. Handholes and boxes.
3. Manholes.

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

B. Utility Structure: Enclosure used as a cable pulling point and to house splices including, handholes, pull boxes and manholes.

C. Duct: A single underground conduit encased in concrete or direct buried.

D. Duct Bank: Two or more ducts run together.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Accessories for utility structures.
4. Dampproofing.
5. Warning tape.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures:

Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

D. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

E. Source quality-control test reports.

F. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to Project site with ends capped.

B. Store nonmetallic ducts according to manufacturer's written instructions or NECA 605, whichever is stricter.

C. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

D. Lift and support precast concrete units only at designated lifting or supporting points.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner's Representative no fewer than ten days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without written permission from Owner's Representative.

1.8 COORDINATION

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Owner's Representative.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: ANSI C80.1. Hot-dip Galvanized.

B. Fittings for Rigid Steel Conduit: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed, UL 514B.

C. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651.

D. Fittings for RNC: NEMA TC 3; match to conduit type and material. By same manufacturer as the conduit.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Cantex, Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless otherwise indicated on Project Drawings. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, as indicated for each service.
4. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
5. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

    a. Type and size shall match fittings to duct or conduit to be terminated.
    b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.

6. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Description: Comply with ANSI/SCTE 77.

1. Color: Gray.
2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
4. Cover Legend: Molded lettering, as indicated for each service.
5. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
6. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armorcast Products Company.
    b. Carson Industries LLC.
    c. CDR Systems Corporation.
    d. Harger Lightning and Grounding
    e. NewBasis.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of cast iron.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Carson Industries LLC.
    b. Christy Concrete Products.
    c. Nordic Fiberglass, Inc.

2.5 PRECAST MANHOLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

a. Type and size shall match fittings to duct or conduit to be terminated.
b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 UTILITY STRUCTURE ACCESSORIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc..
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).

a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in, as indicated for each service.

3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.

a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32- mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1- 1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-

wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24- kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

I. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches (900 mm) high by 4 inches (100 mm) wide, with minimum of 9 holes for arm attachment.
2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 20 inches (508 mm) with 250-lb (114-kg) minimum capacity.
   Top of arm shall be nominally 4 inches (100 mm) wide, and arm shall have slots along full length for cable ties.

J. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

K. Fixed Manhole Ladders: Arranged for attachment to wall and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

L. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater. Two required.

2.7 DAMPPROOFING

A. TREMproof 250GC or approved equal.

2.8 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615

2.9 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by the manufacturer. A

qualified registered professional engineer shall certify tests by manufacturer.

2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA EPC-40-PVC, in concrete- encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

E. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf (13 345-N) vertical loading.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.

2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H- 10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Division 2 but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 02.

D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section.

3.4 DUCT INSTALLATION

A. Install underground duct according to NECA 605.

B. Slope: Pitch ducts a minimum slope of 1:300 (4 inch (101-mm) per 100 feet (30 m)) down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends or field bent conduit, both horizontally and vertically, at other locations, unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Grout end bells into structure walls from both sides to provide watertight entrances.

F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing duct line slope

away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceway and Cabling."

G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

H. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord with footage markings in ducts, including spares.

I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Concrete: 3000 psi (20 kPa) with red dye, 28-day strength, complying with Division 03.

2. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct.
Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

3. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion- contraction damage.
b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.

4. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power- driven agitating equipment unless specifically designed for duct-bank application.

5. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

a. Longitudinal reinforcing steel: Minimum 1/2 inch (12 mm) reinforcing bars, maximum spacing 16 inches (400 mm) with minimum of one bar in each corner of duct bank.
b. Tie bars in transverse direction enclosing the longitudinal bars: Minimum 3/8 inch (9.5 mm) reinforcing bars, maximum spacing 12 inches (300 mm).
c. Minimum clear concrete cover over reinforcement steel: 3 inches (75 mm) where cast directly against earth, 1-1/2 inches (38 mm) where cast directly against forms.

6. Forms: Use walls of trench to form side walls of duct bank where soil is self- supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

7. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.

8. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.

9. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.

10. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.5 Direct-Buried Duct Banks:

A. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

B. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.

C. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 2 for pipes less than 6 inches (150 mm) in nominal diameter.

D. Install backfill as specified in Division 2.

E. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 2.

F. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.

G. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated. Follow depth indicated on duct bank details and coordinate with civil plans to vary depth where required to avoid conflict with other underground utilities.

H. Set elevation of bottom of duct bank below the frost line.

I. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

J. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.

K. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

L. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct- buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF PRECAST CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a 6-inch (152-mm) level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.
6. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

C. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts have been connected and grouted, and before backfilling, dampproof joints and connections and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

D. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
1. For each manhole or handhole provide one stanchion for each 30 linear inches (750 mm) of interior floor perimeter. In addition, provide one arm for each stanchion, three insulators for each arm, and a total of three pulling eyes. Furnish material complete with associated fasteners, package with protective covering for storage and with identification labels clearly describing contents.

E. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

F. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

G. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a 6-inch (152-mm) level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line as required by amended state and local codes.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

1. For each manhole or handhole provide one stanchion for each 30 linear inches (750 mm) of interior floor perimeter. In addition, provide one arm for each stanchion, three insulators for each arm, and a total of three pulling eyes. Furnish material complete with associated fasteners, package with protective covering for storage and with identification labels clearly describing contents.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut.
Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on earth compacted to the same density as adjacent undisturbed earth..

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section

"Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

A. Pull rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION 26 05 43

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

5. To allow removal or full range of movement of portable and mobile equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe", equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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. Advance Products & Systems, Inc.
b. Calpico, Inc.

c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Comply with requirements in Division 07 for calking penetrations and junctions of dissimilar materials.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 4 inches (101.6 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

1. Where subject to vibration or expansion and contraction size pipe sleeve to provide 2 inches (50 mm) minimum annular clear space between sleeve and raceway or cable.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07.

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07.

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07.

END OF SECTION 26 05 44

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Identification for raceway, cable tray and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY, CABLE TRAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: UL 510. inch (19 mm), 7 mil, fade-resistant, vinyl tape, with service temperature of 220 deg F (105 deg C) minimum, color as required.

B. Wire Markers:

1. Sleeve: Polyolefin heat shrink tubing, white, with service temperature of 220 deg F (104 deg C) minimum. Machine printed, in black, by thermal transfer process. Minimum 1-1/2 inches (38 mm) in length.
2. Self-Laminating: White vinyl with service temperature of 225 deg F (107 deg C) minimum, machine printed, in black, by thermal transfer process. Minimum 1-1/2 inches (38 mm) in length.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Warning Labels: Self-adhesive, factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

2.5 INSTRUCTION SIGNS

A. Self-Adhesive, Engraved, laminated acrylic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2.6 EQUIPMENT AND COMPONENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height, 3/16 inch (5 mm).

B. Self-Adhesive, Engraved, Laminated Acrylic: Adhesive backed, with black letters on white background. Minimum letter height, 3/16 inch (5 mm).

C. Engraved, Laminated Acrylic Label: Punched or drilled for screw mounting, with black letters on white background. Minimum letter height, 3/16 inch (5 mm).

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws, or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Accessible Raceways, Cable Trays and Metal-Clad Cables More Than 600 V:

1. Identify with "DANGER-HIGH VOLTAGE – KEEP AWAY" in black letters at least 2 inches (50 mm) high, with self-adhesive vinyl labels or snap-around labels. Repeat legend at 10-foot (3-m) maximum intervals.
2. Identify service and voltage in black letters on an orange background with self-adhesive vinyl labels or snap-around labels. Letters, 2 inches (50 mm) high minimum. Repeat legend at 10-foot (3-m) maximum intervals.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands or snap-around, color- coding bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors in vaults, pull and junction boxes, manholes, handholes and at terminations use color- coding conductor tape and wire markers to identify phase, source and circuit number of each set of conductors. Identify conductors as indicated on Project Drawings.

D. Conductors to Be Extended in the Future: Attach wire marker to conductors and list source and circuit number.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for direct-buried cables, cables in raceway and concrete encased raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Apply to exterior of door, cover, or other access.

1. Identify enclosures with 480VAC system voltage with black letters on yellow background, “CAUTION 480 VOLTS.” Apply to exterior of door or cover.
2. Equipment with Multiple Power or Control Sources: Black letters on yellow background, “CAUTION THIS EQUIPMENT IS SUPPLIED BY MORE THAN ONE POWER SOURCE.” Including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

3. Equipment Requiring Workspace Clearance According to NFPA 70: Black letters on yellow background. Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
4. Arc Flash Warning: Owner supplied; install as indicated on Project Drawings.

H. Instruction Signs:

1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation. Install as indicated on Project Drawings.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer, load shedding, etc. as indicated on Project Drawings.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with Project Drawings unless equipment is provided with its own identification.

1. Labeling Instructions: Unless otherwise indicated, provide a single line of text with ½ inch (13 mm) high letters on 1-inch (25 mm) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.

    a. Indoor Equipment: Adhesive film label or Self-adhesive, engraved, laminated acrylic label.
    b. Outdoor Equipment: Engraved, laminated acrylic label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. For MCC, Switchboard, Panelboard, VFD applications at a minimum the labels should contain:
        - Line 1: Compartment / Location Designation (e.g. bucket location)
        - Line 2: Load Name (e.g. MCC #)
        - Line 3: Frame Size / Trip Rating (e.g. 800AF / 600AT)

2. Equipment to Be Labeled include but not limited to:

    a. Panelboards, electrical cabinets, and enclosures.

b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.
d. Transformers.
e. Electrical substations.
f. Emergency system boxes and enclosures.
g. Motor-control centers.
h. Disconnect switches.
i. Enclosed circuit breakers.
j. Motor starters.
k. Push-button stations.
l. Power transfer equipment.
m. Contactors.
n. Remote-controlled switches, dimmer modules, and control devices.
o. Battery inverter units.
p. Battery racks.
q. Power-generating units.
r. Voice and data cable terminal equipment.
s. Fire-alarm control panel and annunciators.
t. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
u. Monitoring and control equipment.
v. Uninterruptible power supply equipment.
w. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
x. Wiring devices; switches, receptacles, etc.
y. Variable frequency drives.
z. Reactors.

J. Component Identification Labels: Install unique designation labels that are consistent with Shop Drawings or Project Drawings

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and

floors, at 50 foot (15 m) maximum intervals in straight runs, and at 25 foot (7.6 m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208Y/120VAC Circuits:
   a. Phase A: Red.
   b. Phase B: Black.
   c. Phase C: Blue.

3. Colors for 120/240VAC Circuits:
   a. Phase A: Red.
   b. Phase B: Black.
   c. Phase C: Blue.

4. Colors for 480Y/277VAC or 600Y/346VAC Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.

H. Color-Coding for Phase and Voltage Level Identification, more than 600VAC: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be field applied.
   a. Phase A: Red.
   b. Phase B: Black.
   c. Phase C: Blue.

I. Color-Coding for grounded AC current carrying conductors: White.

J. Color-Coding for field control/instrumentation conductors.

1. Color shall be factory applied.
2. 120VAC: Red
3. Intrinsically Safe Circuit: Light Blue; refer to Project Drawings for specific manufacturer and part number.

K. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

L. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below

finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

END OF SECTION 26 05 53

SECTION 26 09 17

PROTECTIVE RELAYS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for protective relays and controllers (also identified as protection relays, protection and control unit or by ANSI/IEEE device numbers) as required for the complete performance of the Work, as shown on the Drawings, as specified herein, and as specified elsewhere for the assemblies or systems comprised of the components specified herein.

B. Related Sections: Related sections include, but shall not be limited to, the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
3. The following information is typically depicted on the Drawings: protection types (ANSI/IEEE C37.2 device numbers), protection levels (basic, standard, advanced), application specific functionality, etc. Where not shown on or able to be derived from the Drawings, the minimum requirements specified herein shall be provided.
4. Refer to the following specifications of equipment containing protective relays or controllers for additional requirements:
    a. Section 26 13 16 Medium Voltage Metal-Enclosed Load Interrupter Switchgear
    b. Section 26 24 13.11 Switchboards

1.2 REFERENCES

A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. International Code Council (ICC)
    a. IBC, “International Building Code”
2. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
    a. ANSI/IEEE C37.2, “Standard for Electrical Power System Device Function Numbers, Acronyms, and Contact Designations”
    b. ANSI/IEEE C57.13, “Standard Requirements for Instrument Transformers”
3. International Electrotechnical Commission (IEC)

a. IEC 61000, “Electromagnetic Compatibility”
b. IEC 61131-3, “Programming Languages”
c. IEC 61850, “Electromagnetic Compatibility”

4. International Organization for Standardization (ISO)
   a. ISO 9001, “Quality Management Systems - Requirements”
   b. ISO 50001, “Energy Management Systems”
5. National Electrical Manufacturers Association (NEMA)
   a. NEMA 250, “Enclosures for Electrical Equipment”
6. National Fire Protection Agency (NFPA)
   a. NFPA 70, “National Electrical Code (NEC)”
7. Underwriter Laboratories (UL)
   a. UL 50, “Enclosures for Electrical Equipment”
   b. UL 508, “Industrial Control Equipment”
   c. UL 991, “Safety Tests for Safety Related Controls Employing Solid State Devices”

1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.
   1. SOTF: Switch On To Fault
   2. In: nominal current (amps)
   3. Un = nominal voltage (volts)
   4. Pn = nominal power (volt-amps)
   5. Qn = nominal active power (watts)
   6. Sn = nominal reactive power (var)

1.4 SUBMITTALS

A. General: Submittals shall be in accordance with the requirements of Section 01 33 00 Submittals and Section 26 00 10 Electrical Requirements, in addition to those specified herein.
   1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.
   2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.

B. Operation & Maintenance (O&M) manuals shall be provided in accordance with the minimum requirements specified in Section 01 78 23 Operation and Maintenance Data, Section 26 00 10 Electrical Requirements and additional requirements specified herein.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.

1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.

2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.

B. Installer Qualifications: Installer shall be a firm that shall have a minimum of 10 years of successful installation experience with projects utilizing equipment similar in type and scope to that required for this Project and shall be approved by the manufacturer's representative.

C. All work performed, and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Equipment assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

1.6 DELIVERY, STORAGE AND HANDLING

A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.7 WARRANTY

A. General: Refer to Section 01 77 00 - Closeout Procedures.

B. The manufacturer shall warrant products against defects in material and workmanship for 10 years from the date of shipment. During the warranty period the manufacturer shall repair or replace

defective products. This warranty shall be in addition to any provided by the Contractor. The warranty shall exclude normal wear and tear under normal usage and any damage caused by abuse, modification, or improper maintenance by entities other than the manufacturer or its approved representative.

C. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 SPECIAL TOOLS AND SPARE PARTS

A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:

1. Contact information for the closest parts stocking location to the Owner.
2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.

B. Spare parts shall be provided for each type and size of unit installed. At a minimum, the following shall be provided:

1. Provide the minimum spare parts recommended by the manufacturer.

C. Any manufacturer specific special tool, not normally found in an electrician’s toolbox, required to remove and install recommended or furnished spare parts shall be furnished. At a minimum the following shall be provided:

1. If available from manufacturer and required to configure equipment, provide PC-based computer configuration software and smart mobile device app tool and a minimum of one communication interface cable for each type of cable required to connect the computer/device to the devices specified herein for configuration and programming.
2. Electronic configuration files, in a media format acceptable by the Owner (e.g. CD, USB stick, etc.), updated to an as installed and commissioned state.

D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Schneider Electric.
2. Schweitzer Engineering Laboratories
3. General Electric.
4. ABB.
5. Basler Electric.

2.2 GENERAL REQUIREMENTS

A. The protective relay shall comply with National, UL, NEMA, EN, CSA, and IEC standards per table below. The protective relay shall be designed with specific protection functions for the application where it will be used.

Protective Relay Standards Table

Category	Requirements	Standards Level
Protective Relays		IEC 60255
Environmental Mechanical constraints		
	In Operation:	
	-Vibrations	IEC 60255-21-1
	-Vibrations	IEC 60068-2-6 Fc
	-Shocks	IEC 60255-21-2
Shocks		IEC 60068-2-27,Ea
	-Seismic	IEC 60255-21-3
Climatic conditions		
	In operation:	
	cold	IEC 60068-2-1 Ad
	dry heat	IEC 60068-2-2 Bd
	damp heat Static	IEC 60068-2-78 Cab
	damp heat cyclic	IEC 60068-2-30 Db
	temperature variation Nb	IEC 60068-2-14
	In storage:	
	cold	IEC 60068-2-1 Ab
	dry heat	IEC 60068-2-2 Bb
Certification		
	CE	EN 50263
harmonized		

2.3 PROTECTIVE RELAY REQUIREMENTS

A. Technology and Functionality: The protective relay design shall be based on a microprocessor technology and shall accommodate a hardware and software architecture consisting of a multifunction and control platform with digital and analog inputs and outputs including: protections, metering, control, monitoring, human machine interface (HMI) with

alphanumeric display, and communication interface. The protective relay shall also provide network, machine, switchgear, and relay diagnostic capabilities.

B. Safety and Dependability (Functional Safety): The protective relay design shall be part of a safety and dependability design process of the manufacturer, associating the four RAMS (Reliability, Availability, Maintainability, and Safety) parameters.

1. Reliability: To define a predictive calculated and field measured MTTF, determine a λ failure rate and a useful lifetime of the protective relay.

2. Availability: To prevent any nuisance or unwanted tripping by selection the adequate settings and improve the continuity of service.

3. Maintainability: To define the time to repair and spare part requirements in the maintenance process.

4. Safety

a. To increase the level of protection safety without lowering the process availability according to IEC 61508 requirements and determine, a P.F.D. (Probability of Failure on Demand), and a S.F.F. (Safe Failure Fraction) measuring the percentage of failures seen by the Watchdog leading to a safe position.

b. The protective relay shall therefore be fitted with an internal self-test monitoring system (Watchdog) testing the relay power supply, acquisition of current and voltage signals, processing unit (memory and processor(s)), software/hardware, and digital inputs/outputs.

c. In the case of an internal failure making the relay inoperable, the relay shall be set in the fail-safe position leading to a fallback position and shall not trip the circuit breaker equipped with shunt coil. All of the protective relay outputs and digital inputs shall be locked in the deactivated position.

d. The watchdog function shall be able to activate a vertical back-up protection architecture based on an upstream protective relay rescuing a downstream defective relay.

e. Any minor, safe, internal failure shall enable the relay to normally perform its protection functions in a downgraded mode.

C. Programming and Configuration

1. The protective relay shall be programmable and configurable with appropriate settings software using a Microsoft Windows based operating system running on a standard personal computer. The programming and configuration shall be done locally (front panel) via a standard communications cable or remotely through a communication network with adequate passwords to prevent unauthorized access.

2. The settings software shall be free of charge and shall not require installation to use.

3. Relay shall be configurable via a built-in webserver, when ethernet port is available.

D. Hardware and Software architecture

1. The protective relay shall accommodate digital and isolated input/outputs. The inputs shall be used to monitor the status of the complete MV/LV panel as well as receive

external signals such as Buchholz, inter-trip, etc. while outputs shall be used for circuit breaker or contactor control, inter-tripping between panels and remote alarms.

2. All protective relays shall allow for 1A or 5A direct CT connections without the need for hardware change.
3. The protective relay shall have an operating temperature range from -25°C to +70°C
4. The circuit breaker control output relay shall be rated to ANSI C37.90 – clause 6.7.
5. CT/VT and trip coil supervision facilities shall be provided to check the wiring circuit continuity with relevant alarms and messages.
6. The protective relay shall be continuously rated and shall maintain the setting accuracy without setting drift over time and full range of auxiliary voltage variation as per the requisition.
7. The protective relay shall be capable of withstanding the output current of the associated current transformers corresponding to a primary current equal to the specified short circuit withstand current and time of the assemble, 4x In permanent and 100x In for 1 second.
8. Any component substitution due to component obsolescence shall not affect the upward compatibility between the protective relays.
9. Relay shall have an option for a remote display.
10. All circuit boards shall be conformal coated

E. The protective relay shall include an LCD mimic bus display for human machine interface (HMI) that indicates measurement values, operating messages, and device maintenance messages. The display shall have, as a minimum, 4 lines of clean annunciation of alarm conditions. The relay shall have a mimic-based display and an option for a remote display.

F. The protective relay shall include a keypad to select the following operations: display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgement, and access to protection and other relay settings.

G. Access to protection setting mode shall be protected by a personal, customized, password of at least 8 characters, access to parameter setting mode shall be protected by a second password, with a minimum, of 8 characters.

H. All functions and displays of the HMI shall be remotely accessible via web browser and smart apps (from the most advantageous location for operation and monitoring).

I. Virtual 3-phase energy injection simulation shall be accessible via relay management software or remotely via web browser.

J. The windows-based relay management software shall include the following:

1. All metering and operating data, including alarm messages
2. Fault recording: single or multi-curve display, two pointers for differential measurement, zoom, pinch, printing, etc.

3. Breaker diagnostic data
4. Protection and parameter settings
5. Logical status of inputs, outputs, and signal LEDs

K. The protective relay shall have at least 9 digital outputs and 6 inputs. Extension of the number of logic inputs and outputs shall be possible up to 24 inputs and 21 outputs or 36 inputs and 9 outputs.

L. Four analog outputs and four analog output plus twelve RTDs inputs (or twelve temperature sensor inputs) shall be available as an extension to the protective relay (Transformer and motor applications).

2.4 EQUIPMENT REQUIREMENTS

A. The protective relay shall be able to be flush mounted or mounted inside the LV compartment and shall have an IP54 front and IP20 rear side mechanical protection degree per IEC60529.

B. To operate properly and to achieve satisfactory operating quality, the Protective Relay shall be installed so that it shall be protected against EMC. As such the following points shall be required:
1. A single equipotential ground (earth) system shall be used as the site potential reference.
2. A power distribution with grounding system
3. Separation of different cable types (power supply, data, measurements)
4. Use of equipotential metallic structure for cable trays
5. Use of screened cables for data and measure
6. Power supply protection (filtering, over voltage)
7. Equipment and installation protection against indirect effects of lightning

2.5 PROTECTION APPLICATION REQUIREMENTS

A. Provide a protective relay for each circuit breaker as specified and as indicated on Drawings. Protective relays shall meet the minimum feature requirements for the protection application (main, feeder, motor, transformer, generator, line differential, etc.) with the protection types (ANSI/IEEE C37.2 device numbers) and protection levels (basic, advanced, advanced differential) specified or shown. Where protection levels or types are not explicitly stated or shown provide the level required to meet the specified protection functionality or provide basic as a minimum protection level of the relay.

B. Main/Feeder Protection Level capabilities
1. Minimum Basic Main/Feeder-Motor Protection Level Capabilities (basic relays are available with or without communication option, and can be configured for feeder or motor protection in the same device)
a. (27P) Phase Undervoltage
b. (27T) Timed Undervoltage Protection

c. (50N) Neutral Instantaneous Overcurrent
d. (50P) Phase Instantaneous Overcurrent
e. (51N) Neutral Time Overcurrent
f. (51P) Phase Time Overcurrent
g. (59P) Phase Overvoltage

2. Minimum Advanced Main/Feeder Protection Level Capabilities
a. (27P) Phase Undervoltage
b. (27T) Timed Undervoltage Protection
c. (50N) Neutral Instantaneous Overcurrent
d. (50P) Phase Instantaneous Overcurrent
e. (51N) Neutral Time Overcurrent
f. (51P) Phase Time Overcurrent
g. (59P) Phase Overvoltage

C. Motor Protection Applications
1. Minimum Advanced Motor Protection (without differential) Level Capabilities
a. (27P) Phase Undervoltage
b. (27T) Timed Undervoltage Protection
c. (50N) Neutral Instantaneous Overcurrent
d. (50P) Phase Instantaneous Overcurrent
e. (51N) Neutral Time Overcurrent
f. (51P) Phase Time Overcurrent
g. (59P) Phase Overvoltage

2.6 PROTECTIVE RELAY METERING MEASUREMENTS

A. The protective relay shall include accurate measurement processing functions and shall display metering data on the Human Machine Interface.

B. Minimum Basic Protection Level Metering Capabilities

Metering	Measurement Range	Accuracy
RMS Phase Current	0.025 to 50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
RMS Residual Current	0.003 to 2xIn	I≤1.5xIn,±0.3%
		I>1.5xIn,±3%
Frequency	16 Hz-75 Hz	±10 mHz
Fundamental frequency Current	0.025-50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
Min/max Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5%

		I>1.5xIn, ±3%
Min/max Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5%
(RMS)		I>1.5xIn, ±3%
Min/max max/min value Current	0.025-50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
Min/max Frequency	16 Hz-75 Hz	±10 mHz
Harmonic value THD current	2nd-15th	

C. Minimum Standard/Advanced Protection Level Metering Capabilities

Metering	Measurement Range	Accuracy
RMS Phase Current	0.025 to 50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
RMS Residual Current	0.003 to 2xIn	I≤1.5xIn,±0.3%
		I>1.5xIn,±3%
RMS L-L Voltage	0.005-1.7xUn	±0.5% or ±0.3 V
RMS L-N Voltage	0.005-1.7xUn	±0.5% or ±0.3 V
RMS active power	±0.1-1.5xPn	±1% for range 0.3-1.5
Pn		
		±3% for range 0.1-0.3
		Pn
RMS reactive power	±0.1-1.5xQn	±1% for range 0.3-1.5
Qn		
		±3% for range 0.1-0.3
		Qn
RMS apparent power	±0.1-1.5xSn	±1% for range 0.3-1.5
Sn		
		±3% for range 0.1-0.3
		Sn
Frequency	16 Hz-75 Hz	±10 mHz
Fundamental frequency Current	0.025-50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
Fundamental frequency Voltage	0.005-1.7xUn	±0.5% or ±0.3 V
Fundamental frequency	±0.1-1.5xPn	±1% for range 0.3-1.5
Pn		
active power		±3% for range 0.1-0.3
Pn		

Fundamental frequency Qn	±0.1-1.5xQn	±1% for range 0.3-1.5
reactive power Qn		±3% for range 0.1-0.3
Fundamental frequency Sn	±0.1-1.5xSn	±1% for range 0.3-1.5
apparent power Sn		±3% for range 0.1-0.3
Power factor PF>0.5		±2° or ±0.02 for
Active energy EPn		±1%/1h range 0.3-1.5
EPn		±3%/1h range 0.1-0.3
reactive energy EQn		±1%/1h range 0.3-1.5
EQn		±3%/1hrange 0.1-0.3
Energy transmitted with Pulse EPn		±1%/1h range 0.3-1.5
EPn		±3%/1h range 0.1-0.3
Active power demand Pn	±0.1-1.5xPn	±1% for range 0.3-1.5
Pn		±3% for range 0.1-0.3
Reactive power demand Qn	±0.1-1.5xQn	±1% for range 0.3-1.5
Qn		±3% for range 0.1-0.3
Apparent power demand Sn	±0.1-1.5xSn	±1% for range 0.3-1.5
Sn		±3% for range 0.1-0.3
Power factor demand PF>0.5		±2° or ±0.02 for
Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5% I>1.5xIn, ±3%
Min/max Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5%

		I>1.5xIn, ±3%
Min/max Demand Current	0.025-50xIn	I≤1.5xIn, ±0.5%
(RMS)		I>1.5xIn, ±3%
min/max demand values P,Q,Sn		±1%, range 0.3-1.5
Active, Reactive, Apparent P,Q,Sn		±3%, range 0.1-0.3
max/min value Current	0.025-50xIn	I≤1.5xIn, ±0.5%
		I>1.5xIn, ±3%
max/min value, Voltage	0.005-1.7xUn	±0.5% or ±0.3 V
Min/max Frequency	16 Hz-75 Hz	±10 mHz
Harmonic value THD current	2nd-15th	
Harmonic value THD voltage	2nd-15th	
Voltage sags and Swells PF>0.5	0.005-1.7xUn	±2° or ±0.02 for

2.7 PROTECTIVE RELAY DIAGNOSTICS

A. The protective relay shall contain self-test diagnostics facilities to:

1. Detect internal relay failures that may cause nuisance tripping or failed fault tripping.
2. Set the relay in fail-safe position leading to a fallback position to avoid any unwanted tripping if a major internal fault is detected. A form C watchdog relay shall provide an alarm or information to activate a back-up protection. Any minor failure shall not interrupt the protection function operations and the relay shall operate in downgraded mode.
3. Inform for maintenance operation
4. Check the hardware configuration
5. The absence or failure of a remote module shall be considered a minor failure
6. The absence or failure of a logic input/output module shall be considered as a major failure

2.8 PROTECTIVE RELAY COMMUNICATION

A. The protective relay shall be capable of communicating through one or two communication ports and shall use open communication protocols to allow for remote information access.

B. The relay protocols shall be dependent upon the medium of communication only; no additional ordering option for a specific protocol shall be required.

C. The protective relay shall use open communications protocols includes:

1. Modbus RTU
2. Modbus TCP/IP
3. DNP3 (Serial and Ethernet)
4. IEC61850 (edition 1 and 2)
5. Profibus DP
6. DeviceNET
7. SPAbus
8. IEC 60870-5-101 and 103

D. The protective relay shall be capable of concurrent multiple communication protocols.

E. In absence of setting software, relay is accessible via embedded web browser and/or smart apps.

PART 3 - EXECUTION

3.1 GENERAL

A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of specifications Section 26 00 10, Section 26 08 00 and Drawings.

B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

D. Pre-Installation Conference: Prior to commencing the installation, an onsite pre-installation conference shall review the material selections, installation procedures, and coordination with other trades. Attendees shall include, but shall not be limited to, the Contractor, the Installer, manufacturer’s representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Engineer

E. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

F. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.

G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

3.2 FACTORY ACCEPTANCE TESTING

3.3 FIELD QUALITY CONTROL

A. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer's field service representative. This manufacturer's field service technician shall provide all material, equipment, labor and technical supervision to perform inspection, testing and adjustments to ensure equipment is installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation. The manufacturer's field service technician shall replace damaged or malfunctioning equipment and report to the Engineer any discrepancies or issues with the installation.

B. The manufacturer's representative shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.

3.4 FIELD TESTING AND COMMISSIONING

A. Protection Settings

1. The qualified manufacturer's representative shall configure the protection settings of the relay to provide the specified functionality per the settings provided in the power system study for the project. Refer to specification Section 26 05 73 Power System Studies.

B. Operational Readiness Testing

1. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture's recommendations, and readiness for operation. The test shall include the following as a minimum:
   a. Visually inspect for physical damage and proper installation
   b. Perform tests in accordance with manufacturer's instructions
   c. Perform tests to ensure compliance with Contract Documents
   d. Perform tests that equipment is ready for operation
   e. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner
2. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation. The test report shall include a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

C. Functional Demonstration Testing

1. Prior to scheduling functional demonstration testing the Contractor shall submit a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

2. The Contractor shall completely demonstrate the functionality and performance of the equipment and associated systems in the presence of Owner and Engineer, observing and documenting complete compliance with the Contract Documents.

3. The Contractor shall submit a written report documenting successful completion of functional demonstrating testing including all assumptions, conditions, allowances and corrections made during the test.

3.5 TRAINING

A. O&M Training: Onsite training specific to the equipment furnished shall be provided to the Owner's staff by a factory trained manufacturer's representative. Training duration shall be sufficiently adequate to cover the operation and maintenance of the equipment and shall consist of not less than 1 session(s) with 4 hours of onsite classroom and hands-on instruction for a minimum of 4 attendees per session.

1. The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:
   a. Theory of operation
   b. Major components of equipment
   c. Operation of equipment
   d. Configurations of equipment
   e. Maintenance, troubleshooting and repair
   f. Replacement of component level parts

2. The submitted O&M manuals shall be used for training.

END OF SECTION 26 09 17

SECTION 26 12 16

MEDIUM-VOLTAGE DRY TYPE VPI TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for medium voltage dry type VPI substation transformers (also identified as MV XFMR, XFMR) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.

A. Related Sections: Related sections include, but shall not be limited to, the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
3. Refer to specification Section 26 11 13 Unit Substations for additional requirements.

1.2 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

1. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
    a. IEEE C57.12.01, “Standard General requirements for Dry Type Distribution and Power transformers including those with Solid Cast or Resin-Encapsulated Windings.”
    b. IEEE C57.12.28 , “Switchgear and Transformers, Pad-Mounted Equipment - Enclosure Integrity”
    c. IEEE C57.12.50, “Requirements for Ventilated Dry-Type Distribution Transformers, 1–500 kVA Single-Phase and 15–500 kVA Three-Phase”
    d. IEEE C57.12.51, “Requirements for Ventilated Dry-Type Power Transformers, 501 kVA and larger Three-Phase, with High Voltage 601–34,500 Volts, Low Voltage 208Y/120–4,160 Volts”
    e. IEEE C57.12.55, “Conformance Standard for Transformers—Dry-Type Transformers Used in Unit Installations, including Unit Substations”
    f. IEEE C57.12.56, “Standard Test Procedure for Thermal Evaluation of Insulation Systems for Ventilated Dry-Type Power and Distribution Transformers”
    g. IEEE C57.12.58”, Guide for Conducting a Transient Voltage Analysis of a Dry-Type Transformer Coil”

h. IEEE C57.12.59, "Guide for Dry-Type Transformer Through-Fault Current Duration"

i. IEEE C57.12.70, "Terminal Markings and Connections for Distribution and Power Transformers"

j. IEEE C57.12.80, "Standard Terminology for Power and Distribution Transformers"

k. IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers"

l. IEEE C57.94, "Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers"

m. IEEE C57.96, "Guide for Loading Dry-Type Distribution and Power Transformers"

n. IEEE C57.105, "Guide for Application of Transformer Connections in Three-Phase Distribution Systems"

o. IEEE C57.124, "Recommended Practice for the Detection of Partial Discharges and the Measurement of Apparent Charge in Dry-Type Transformers"

2. International Organization for Standardization (ISO):
   a. ISO 9001, "Quality Management Systems - Requirements"

3. National Electrical Manufacturers Association (NEMA)
   a. TR 1, "Transformers, Regulators and Reactors"

4. Underwriters Laboratories, Inc. (UL):
   a. UL 1561, "Standard for Dry-Type General Purpose and Power Transformers"

5. USA Federal Regulations, Policies and Acts
   a. Energy Policy and Conservation Act 1975 & Energy Policy Act 2005
   b. 10 CFR 429 - Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment
   c. 10 CFR 431 – Energy Efficient Program for Certain Commercial and Industrial Equipment

1.3 DEFINITIONS

A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

1. MV: Medium voltage
2. VPI: Vacuum-Pressure Impregnated
3. XFMR: Transformer
4. AA: Ambient Air
5. AA/FA: Ambient Air / Forced Air
6. FA: Forced Air

1.4 SUBMITTALS

A. General: Submittals shall be in accordance specified herein.

1. Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain. Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.

2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.

1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.

2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.

B. Installer Qualifications: Installer shall be a firm that shall have a minimum of 10 years of successful installation experience with projects utilizing equipment similar in type and scope to that required for this Project [and shall be approved by the manufacturer’s representative].

C. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Equipment assemblies, materials, and equipment shall be listed and labeled by Underwriter’s Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.

B. Deliver materials to the Project site in supplier’s or manufacturer’s original wrappings and containers, labeled with supplier’s or manufacturer’s name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

1.7 WARRANTY

A. The manufacturer shall warrant products against defects in material and workmanship for 24 months from the date of commissioning or 36 months from the date of shipment, whichever comes first, provided that the manufacturer performs functional testing, commissioning and first parameter adjusting of equipment. During the warranty period the manufacturer shall repair or replace defective products. This warranty shall be in addition to any provided by the Contractor. The warranty shall exclude normal wear and tear under normal usage and any damage caused by abuse, modification, or improper maintenance by entities other than the manufacturer or its approved representative.

B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.8 SPECIAL TOOLS AND SPARE PARTS

A. The Contractor shall provide a recommended spare parts list with the following information provided as a minimum:

1. Contact information for the closest parts stocking location to the Owner.
2. Critical spare parts shall be identified as those parts being associated with long lead times and/or those being critical to the unit's operation.
3. Maintenance spares shall be identified as being those parts required to regularly perform scheduled maintenance on the furnished equipment. These spares shall include, but shall not be limited to, consumable spares that are required to be exchanged during scheduled maintenance periods.

B. Spare parts shall be provided for each type and size of unit furnished. At a minimum, the following shall be provided:

1. Provide the minimum spare parts recommended by the manufacturer.

C. Any manufacturer specific special tool, not normally found in an electrician’s toolbox, required to remove and install recommended or furnished spare parts shall be furnished.

D. Spare parts shall be properly marked and packaged for long term storage. Printed circuit boards shall be provided in separate anti-static containers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Square D Power-Dry II™ VPI Substation Transformers.

B. Acceptable Products: MV XFMRs specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:

1. Square D Power-Dry II™ Substation Transformers by Schneider Electric
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. ABB/GE.

C. The transformers shall be furnished by others.

2.2 MV DRY TYPE VPI SUBSTATION TRANSFORMERS

A. The transformer(s) shall be UL listed and labeled substation type per UL1561 with side-mounted primary and side-mounted secondary terminations. Transformers shall comply with 10 CFR 431 as registered on US Department of Energy's Compliance Certification Database per 10 CFR 429

B. High voltage terminations shall be designed for connection to air terminal compartment. Low voltage terminations shall be designed for close coupling to a switchboard section.

C. Orientation shall be as shown on drawings.

D. The transformer(s) shall be rated 2500 kVA AA / 3333 kVA FFA. High voltage: 12.47kV delta. Low voltage: 480/277V wye, 4-wire, 60 Hz with two 2-1/2% full capacity above normal and two 2-1/2% full capacity below normal primary taps. Impedance shall be manufacturer's standard impedance, ±7-1/2%. All transformers shall have an average temperature rise of 150° C above a 40° C maximum, 30° C average ambient.

E. Fan cooling equipment shall include 3-phase electronic winding temperature monitor controlled automatically by a Type K thermocouples placed in the low voltage air duct. The temperature monitor shall contain yellow and red indicating lights. The yellow lamp shall indicate fan power, while the red lamp signals that alarm and trip contacts have been activated. An adjustable analog milliampere output shall be required for remote indication. Alarm contacts shall be provided for fans, alarm, and trip function. An audible alarm shall sound when the highest phase temperature exceeds a preset point. The fans shall be able to operate in either manual or automatic mode. Minimum six fans shall be provided. Fan controller must be type Model 98A, POWERLOGIC ® system compatible. Forced air cooling system shall include: fans, control wiring, controller with test switch, current limiting fused in the power supply to the controller, indications lights, alarm silencing relay, auto/manual switch, and necessary accessories to properly control the system.

F. The basic impulse levels (BIL) shall be a minimum of 60 kV for the 15 kV class.

G. The coils shall be wound with copper conductors.

H. All insulating materials are to be in accordance with IEEE Standard C57.12.01 for 220° C UL insulation system.

I. All cores to be constructed of high grade, grain-oriented, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point. Core laminations shall be step-lap miter cut at the core corners to reduce hot spots, core loss, excitation current, and sound level. The core shall be visibly grounded to the ground bus or ground pad by means of a flexible grounding conductor.

J. The coils and all clamping structure shall be assembled on the core, and then dried at atmospheric pressure in an oven through which hot air is continuously circulated. The totally assembled core and coil assembly shall be vacuum pressure impregnated in polyester varnish. The total VPI process shall apply a one (1) cycle polyester protective shield of varnish to the core and coils. The varnish shall be cured on the core and coil assembly following an established temperature vs. time baking cycle in a hot air circulating oven. The VPI process shall effectively impregnate the entire core and coil assembly, which results in a unit, which is virtually impermeable to moisture, dust, salt air and other industrial contaminants.

K. The transformer enclosures shall be fabricated of heavy gauge, sheet steel construction and ventilated indoor as required by plans. Enclosures are to be provided with lifting provisions on the base structure and shall have jacking pads designed to be flush with the enclosure. The base is to be constructed of steel members to permit skidding or rolling in any direction. Rubber vibration isolation pads shall be installed by the manufacturer between the core and coil and the enclosure.

L. The paint color shall be ANSI 49.

M. Transformer sound levels shall be warranted by the manufacturer not to exceed the values specified in IEEE Std. C57.12.01.

N. Metal-oxide, gapless-type distribution class lightning arresters shall not be installed by the manufacturer on the high voltage side of the transformer to provide additional protection against high voltage lightning or switching surges.

2.3 TESTING

A. Testing shall be done in accordance with IEEE C57.12.91 and shall include, as the minimum, the following tests:
   1. Ratio
   2. Polarity
   3. Phase Rotation
   4. No-Load Loss
   5. Excitation Current
   6. Impedance Voltage
   7. Load Loss

8. Applied Potential
9. Induced Potential
10. QC Impulse Test
11. Temperature Test
12. Sound Test
13. Partial Discharge testing

2.4 MARKINGS AND LABELING

A. All identification and warning labels and nameplates exterior to the MV Transformer shall be resistant to weather, UV, and their intended installation environment.

B. Each MV Transformer shall be provided with an engraved nameplate identifying the project specific equipment tag and service description.

C. Warning labels and nameplates shall be present at access locations to advise personnel of possible hazards.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.

B. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

C. Pre-Installation Conference: Prior to commencing the installation, an onsite pre-installation conference shall review the material selections, installation procedures, and coordination with other trades. Attendees shall include, but shall not be limited to, the Contractor, the Installer, manufacturer’s representatives, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Engineer

D. The transformers shall be installed by the electrical contractor. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer’s written instructions and recommendations, and as indicated on the Drawings.

F. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

3.2 FACTORY ACCEPTANCE TESTING

3.3 FIELD QUALITY CONTROL

A. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory-trained manufacturer's field service representative. This manufacturer's field service technician shall provide all material, equipment, labor and technical supervision to perform inspection, testing and adjustments to ensure equipment is installed, adjusted, and tested in accordance with the manufacturer's recommendations and is ready for operation. The manufacturer's field service technician shall replace damaged or malfunctioning equipment and report to the Engineer any discrepancies or issues with the installation.

B. The manufacturer's representative shall, upon satisfactory completion of inspection and testing, attach a label to all serviced devices indicating the date serviced and testing company responsible.

3.4 FIELD TESTING AND COMMISSIONING

A. Operational Readiness Testing

1. The Contractor shall inspect and test furnished equipment and associated systems for conformance to the contract documents, including equipment manufacture's recommendations, and readiness for operation. The test shall include the following as a minimum:

   a. Visually inspect for physical damage and proper installation

   b. Perform tests in accordance with manufacturer's instructions

   c. Perform tests to ensure compliance with Contract Documents

   d. Perform tests that equipment is ready for operation

   e. Touch-up paint all chips and scratches with manufacturer-supplied paint and transfer remaining paint to Owner

2. Contractor shall submit an operational readiness test report documenting all test results, including all assumptions, conditions, allowances and corrections made during the test. The report shall provide a listing of all modifications and adjustments made onsite to include any settings / parameters not identified as factory defaults within the equipment's O&M documentation. The test report shall include a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

B. Functional Demonstration Testing

1. Prior to scheduling functional demonstration testing the Contractor shall submit a signed statement from the Contractor, installer(s) and the factory-trained manufacturer's representative(s) certifying that the furnished equipment and associated system have been installed, configured, and tested in accordance with the

manufacturer's recommendations, completely conforms to the requirements of the Contract Documents and is ready for operation.

2. The Contractor shall completely demonstrate the functionality and performance of the equipment and associated systems in the presence of Owner and Engineer, observing and documenting complete compliance with the Contract Documents.

3. The Contractor shall submit a written report documenting successful completion of functional demonstrating testing including all assumptions, conditions, allowances and corrections made during the test.

3.5 TRAINING

A. O&M Training: Onsite training specific to the equipment furnished shall be provided to the Owner's staff by a factory trained manufacturer's representative. Training duration shall be sufficiently adequate to cover the operation and maintenance of the equipment and shall consist of not less than 1 sessions with 2 hours of onsite classroom and hands-on instruction for a minimum of 4 attendees per session.

1. The instructor shall provide sufficient time and detail in each session to cover the following as a minimum:
   a. Theory of operation
   b. Major components of equipment
   c. Operation of equipment
   d. Configurations of equipment
   e. Maintenance, troubleshooting and repair
   f. Replacement of component level parts

2. The submitted O&M manuals shall be used for training.

END OF SECTION 26 12 16

SECTION 26 13 13

MEDIUM-VOLTAGE, METAL-ENCLOSED CIRCUIT BREAKER SWITCHGEAR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes outdoor metal-enclosed circuit breaker switchgear.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For medium-voltage, metal-enclosed switchgear.

1. Include a tabulation of installed devices with features and ratings.
2. Include dimensioned plans and elevations, showing dimensions, shipping sections, and weights of each assembled section. Elevations shall show major components, features, and mimic bus diagram.
3. Include a plan view and cross section of equipment base showing clearances, manufacturer's recommended workspace, and locations of penetrations for grounding and conduits. Show location of anchor bolts and leveling channels.
4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, and location and size of each field connection.
5. Include single-line diagram.
6. Include control power wiring diagrams.
7. Include copy of nameplate.
8. Ratings of the assembled switchgear:

    a. Voltage.
    b. Continuous current.
    c. Short-circuit rating.
    d. BIL.

9. Wiring Diagrams: For each switchgear assembly include the following:

    a. Power, signal, and control wiring.
    b. Three-line diagrams of current and future secondary circuits showing device terminal numbers and internal diagrams.
    c. Schematic control diagrams.

d. Diagrams showing connections of component devices and equipment.
e. Schematic diagrams showing connections to remote devices.

1.3 INFORMATIONAL SUBMITTALS

B. Product certificates.

C. Source quality-control reports.

D. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer able to provide service response within 24 hours for training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Manufactured Unit: Metal-enclosed switchgear, designed for application in solidly grounded neutral system.

B. Switchgear Components, Devices, and Accessories: UL Listed and labeled, and marked for intended location and application.

C. Comply with IEEE C37.20.3.

2.2 MANUFACTURERS

A. 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:

1. Eaton.
2. Siemens Industry, Inc., Energy Management Division.
3. Square D; by Schneider Electric.
4. ABB/GE.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: The switchgear shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means the switchgear will remain in place without separation of any parts when subjected to the seismic forces specified."

B. Service Conditions:

1. Switchgear shall be suitable for operation under service conditions specified as usual service conditions in IEEE C37.20.3.

a. None.

2.4 SWITCHGEAR ENCLOSURE

A. Indoor Enclosure made up of 11 gauge steel, completely grounded, shatter resistant safety glass viewing ports, interlocked removable front panels for access, provisions for future expansion, full length ground bus, key interlocking.

1. Each vertical section shall have the following features:
   a. Space heater sized to prevent condensation, controlled by thermostats to maintain temperature of each section above expected dew point.
   b. Louvers equipped with insect and rodent screens and filters and arranged to permit air circulation while excluding rodents and exterior dust.
   c. Weatherproof ground-fault circuit interrupter duplex receptacle.
   d. Power for heaters and receptacles shall be provided by control power transformer.

B. Switchgear Enclosures Finish: Factory-applied finish in manufacturer's standard color, including under surfaces treated with corrosion-resistant undercoating.

2.5 METAL-CLAD, CIRCUIT-BREAKER SWITCHGEAR

A. Circuit Breakers: Vacuum SF-6 or Air; Three-pole, single-throw, electrically operated, drawout-mounting units using three individual, vacuum-sealed interrupter modules and including the following features:

1. Designed to operate at rated voltage to interrupt fault current within its rating within five cycles of trip initiation.
2. Contact-Wear Indicator: Readily accessible to field maintenance personnel.
3. Minimum of six Type A and six Type B spare contacts wired to terminal blocks.
4. Indication of circuit breaker contact position, OPEN Ó CLOSED and connection, CONNECT - DISCONNECT.
5. Interchangeability:Circuit breakers are interchangeable with vacuum circuit breakers of same current and interrupting ratings.

    a. Current Rating of Main Circuit Breaker: As indicated.
    b. Continuous Current Rating of Tie Circuit Breaker: As indicated.
    c. Continuous Current Rating of Feeder Circuit Breaker: As indicated.

6. Operating Mechanism: Electrically charged, mechanically and electrically trip- free, stored-energy operated.

    a. Closing speed of moving contacts to be independent of both control and operator.
    b. Design mechanism to permit manual charging and slow closing of contacts for inspection or adjustment.
    c. Control Power: Close and trip voltage as indicated.
    d. Provide shunt trip capability independent of overcurrent trip.

B. Manual Racking Handle: One per line-up.

C. Circuit-Breaker Test Cabinet: Separately mounted and containing push buttons for circuit-breaker closing and tripping, control relay, fuses, and secondary coupler with cable of sufficient length. Include a set of secondary devices for operating circuit breaker if removed from switchgear and moved near test cabinet. Include provision for storage of test and maintenance accessories in cabinet.

D. Key Interlocks: Arranged to effect interlocking schemes indicated.

2.6 POWER TRANSFER CONFIGURATIONS

A. Main-Tie-Main Manual Transfer for the MV Circuit Breaker switchgear.

1. MV Circuit breaker switchgear assembly each with a load bus and two normally energized medium-voltage power sources, designated "Main-A" and "Main-B," connected to the load bus using MV Circuit Breakers.
2. Each side load bus side A and side B are connected by a normally open 'Tie' MV Circuit Breaker.
3. Key interlock arranged so that only two Circuit Breakers are closed at one time.

2.7 INSTRUMENTS

A. Instrument Transformers: Comply with IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C 12.11 accuracy maximum ratio error of +/-0.3 % with burdens of W, X, and Y.
2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.

B. Multifunction Digital Meter and Monitor: Microprocessor-based unit suitable for three- or four-wire systems.

1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
2. Switch-selectable digital display with the following features:

    a. Phase Currents, Each Phase: Plus or minus 1 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    d. Three-Phase Real Power: Plus or minus 2 percent.
    e. Three-Phase Reactive Power: Plus or minus 2 percent.
    f. Power Factor: Plus or minus 2 percent.
    g. Frequency: Plus or minus 0.5 percent.
    h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
    i. Accumulated energy, in kilowatt hours, plus or minus 2 percent; stored values unaffected by power outages for up to 72 hours
    j. Stored values to included average, max, daily and monthly totals.

3. Communications module suitable for remote monitoring of meter quantities and functions. Interface communication and metering requirements according to Section 260913 "Electrical Power Monitoring and Control."
4. Ethernet to Fiber converter for 38kV Service Switchgear (outdoor)
5. Mounting: Display and control unit that is flush or semi flush mounted in instrument compartment door.

2.8 PROTECTIVE RELAYS

A. Multifunctional, solid-state microprocessor-based relay systems complying with IEEE C37.90.

B. Relay Mounting:

1. Each relay shall be mounted in a drawout case with a two-stage quick-release operation.
2. Removal of the relay from the case shall disconnect the trip circuits and short the current-transformer secondaries before the unit control power is disconnected.
3. When the relay is inserted into the case, control power connections shall be made before the trip circuits are activated.
4. Include a self-shorting contact on the case terminal block for alarm indication and tripping of circuit breaker upon removal of the relay from the case.

C. Equip each relay system with a communications module to transmit the following data according to Section 260913 "Electrical Power Monitoring and Control."

1. Relay's metered and target data, such as currents, set points, cause of trip, magnitude of trip current, and open-close trip status.
2. Ability to close and open the associated breaker with proper access code from remote location over the communication network when the relay is configured in remote open-close mode.

D. Overcurrent and Ground-Fault Protective Relays:

1. IEEE C37.2 Device Functions: 51/50 and 51/50G .
2. Field-Selectable Relay Settings: Required by the overcurrent protective device coordination study and arc-flash study.
3. Primary Current-Transformer Ratings: Programmable from 5 to 5000 A.
4. Phase and Ground Protection: Field-selectable curves from IEEE moderately inverse, very inverse, or extremely inverse.
5. Phase Instantaneous Overcurrent Trip Pickup Point: Field selectable as "none" or from 1.0 to 25 times current-transformer primary rating. Include discriminator circuit with "on" and "off" switch so that when phase instantaneous overcurrent has been programmed to "none," the discriminator circuit protects against currents exceeding 11 times current-transformer primary rating when the breaker is being closed and shall be deactivated after approximately eight cycles.
6. Contacts:

a. Two Form-C contacts.

b. Field selectable into contact pairs as follows and as required by the overcurrent protective device coordination study and arc-flash study:

1) One contact assigned ANSI 51 phase and ANSI 51 ground, and the other contact assigned ANSI 50 phase and ANSI 50 ground.
2) One contact assigned ANSI 51/50 phase, and the other contact assigned 51/50 ground.

7. Alphanumeric display to show the following parameters with metering accuracy not to exceed 2 percent of full scale:

a. Individual phase currents.
b. Ground current.
c. Cause of trip.
d. Magnitude and phase of current-causing trip.
e. Phase or ground indication.
f. Peak current demand for each phase and ground since last reset.
g. Current-transformer primary rating.
h. Programmed phase and ground set points.

8. Relay alarm and trip contacts shall not change state if power is lost or an undervoltage occurs. These contacts shall only cause a trip on detection of an overcurrent or fault condition based on programmed settings. Provide a "protection off" alarm, which shall be normally energized when the relay is powered, and the self-diagnostics indicates the unit is functional. On loss of power or relay failure, this alarm relay shall be de-energized, providing a fail-safe protection off alarm.

E. 86 Lockout Relay.

F. 21 Distance Relay.

G. 27 Undervoltage Relay.

H. 59 Overvoltage Relay.

I. 47 Phase Balance Relay

2.9 CONTROL POWER SUPPLY

A. Description: Control power transformer shall supply 120-V control circuits through secondary disconnect and overcurrent protective devices.

1. Dry-type transformer, in separate compartment, with primary and secondary fuses to provide current-limiting and overload protection.

2.10 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

1. Equipment Identification Labels: Stenciled legend, minimum 4 inches high.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide a factory-authorized service representative to perform the following

1. Inspect switchgear, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
2. Assist in field testing of equipment
3. Report results in writing.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 26 13 13

SECTION 26 22 00

600 VOLT TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes dry-type distribution transformers rated 600 V and less, with capacities up to 1000 kVA.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: Include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction,

and marked for intended use.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install transformers until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above transformers is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 deg F (plus 40 deg C), with average temperature, in 24 hours, not exceeding 86 deg F (30 deg C).
    b. Altitude: Not exceeding 3300 feet (1000 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner's Representative no fewer than ten days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electric service without written permission from Owner's Representative.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle according to NECA 409 "Installing and Maintaining Dry-Type Transformers" and manufacturer's written instructions.

B. Store in a warm, dry location with uniform temperature. Cover ventilating opening to keep out dust and protect against exposure to fumes, water, corrosive substances, and physical damage.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is

continuously under normal control of temperature and humidity.

1.7 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section “Cast-In-Place Concrete.”

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACME Electric Corporation; Power Distribution Products Division.
2. Eaton Electrical Inc.; Cutler-Hammer Products.
3. General Electric Company.
4. Magnetek Power Electronics Group.
5. Siemens Energy & Automation, Inc.
6. Sola/Hevi-Duty.
7. Square D; Schneider Electric.

B. The transformers shall be furnished by others.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum (Copper- optional).

D. Isolate core and coils assemblies from enclosure with vibration absorbing mounts.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Ground core and coil assembly to enclosure with a visible flexible copper ground strap.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Manufacturer's standard Gray.

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 5 to 24 kVA: Two 5 percent taps below rated voltage.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

K. Wall Brackets: Manufacturer's standard brackets or constructed in accordance with Division 26 "Hangers and Supports for Electrical Systems."

L. Sound-Level Requirements: NEMA ST 20 standard sound levels.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division.26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The transformers shall be installed by the electrical contractor.

B. Install transformers according to NEC 409.

C. Install wall-mounting transformers level and plumb with wall brackets.

D. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions. Concrete base is specified in Division 26 Section “Hangers and Supports for Electrical Systems”, and concrete materials and installation requirements are specified in Division 03.

E. Install sound dampening pads between transformer and mounting surface.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems.”

B. Connect wiring according to Division 26 Section "600 Volt Electrical Power Conductors and Cables.”

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

    a. Use an infrared-scanning device designed to measure temperature or detects significant deviations from normal values. Provide documentation of device calibration.

    b. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

    c. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Prepare test and inspection reports, including a certified report that identifies transformers included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 23 00

600 VOLT SWITCHGEAR

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal-enclosed, low-voltage switchgear, with drawout power circuit breakers and metering and control accessories.

1. Switchgear structure.
2. Requirements for indoor switchgear.
3. Circuit breakers.
4. Surge suppression.
5. Control power supply, 120-V ac.
6. Instrumentation and control.
7. Identification.
8. Source quality control.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For low-voltage switchgear.

1. System Power One-Line Diagrams: Depict power sources, feeders, distribution components, and major loads. Include as-built data for low-voltage power switchgear and connections.
2. Include plans, elevations, sections, shipping splits, and mounting details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.
5. Indicate short-time and short-circuit current rating of switchgear assembly.
6. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include mimic-bus diagram.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around the low-voltage switchgear where pipe and ducts are prohibited.

B. Source quality-control reports.

C. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C2.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchgear in shipping widths indicated, individually wrapped for protection and mounted on shipping skids.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250 W per section) or connect factory installed space heaters to temporary electrical service to prevent condensation.

D. Handle switchgear according to NECA 400, “Installing and Maintaining Switchboards” and manufacturer’s written instruction. Lift only with lugs provided for the purpose.

Handle carefully to avoid damage to enclosure and finish.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner's Representative no fewer than ten days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electric service without written permission from Owner's Representative.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03, Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Cutler-Hammer, Inc.
2. Siemens Industry, Inc., Energy Management Division.

3. Square D; by Schneider Electric.
4. ABB/GE.

B. The switchgear shall be furnished by others.

2.2 SYSTEM DESCRIPTION

A. Description: Metal-enclosed, low-voltage switchgear with drawout power circuit breakers, with accessories and metering components.

B. ANSI C37.20.7 Compartmentalized and barriered construction between main and tie breaker and feeder Sections to allow for main breaker used as clearing device for feeder sections and main breaker will have different arch flash rating/ label than feeder sections.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C37.20.1.

E. Listed and labeled as complying with UL 1558.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchgear shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Capacities and Characteristics:

1. Nominal System Voltage: 480/277 V, four wire, 60 Hz.
2. Rated Insulation Level: Power frequency withstand shall be not less than 2.2-kV rms.
3. Rated Main-Bus Continuous Current: 3000 A.
4. Rated Short-Circuit Withstand Current: 85,000 A symmetrical.
5. Short-Time and Short-Circuit Current: Match rating of integrated short-circuit current rating.

2.4 SWITCHGEAR STRUCTURE

A. Allow circuit-breaker functions to be performed when the compartment door is closed.

B. Install instrument compartments when additional space is required for metering and instrumentation. Allow for routing of instrumentation, control and communications

wires, and cables.

C. Switchgear Bus:

1. Use bus bars to connect compartments and vertical sections. Cable connections are not permitted.
2. Main Phase Bus: Uniform capacity the entire length of assembly.
3. Neutral Bus: 100 percent of phase-bus ampacity unless otherwise indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors.
4. Ground Bus: Uniform capacity the entire length of assembly, with pressure connector terminations for feeder and branch-circuit ground conductors, minimum size 1/4 by 2 inches.
5. Bus Material and Connections:

    a. Phase- and Neutral-Bus Material: Silver -Plated Hard-drawn copper of 98 percent minimum conductivity, with copper feeder circuit-breaker line connections.
    b. Use copper for connecting circuit-breaker line to copper bus.
    c. Contact Surfaces of Buses: Silver plated.
    d. Feeder Circuit-Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

6. Neutral Disconnect Link: Bolted, uninsulated, bus, arranged to connect neutral bus to ground bus.

D. Enclosure Rating: Indoor.

E. Enclosure Material: Steel.

F. Compartmentalized Construction: A front (circuit breaker, auxiliary) compartment, a bus compartment, and a rear cable compartment.

1. Isolate bus compartment from cable compartment with steel barriers.
2. Isolate each vertical section in cable compartment with steel side barriers.
3. Segregate circuit breaker compartment from adjacent compartments and sections with steel barriers.
4. Segregate vertical section in bus compartment with insulating barriers with slots for main bus.

G. Enclosure Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.

H. Enclosure Rear Panels: Removable and hinged, to allow access to rear interior of switchgear.

2.5 CIRCUIT BREAKERS

A. Drawout type, unfused, power operated, with electromechanical or electronic trip devices. Comply with IEEE C37.13, IEEE C37.13a, and UL 1066.

B. All Breakers 100% Rated and include ARMS/ERMS for Arc Flash Reduction.

C. Ratings: For continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear. Comply with IEEE C37.16.

D. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: Independent of both control and operator.
2. Slow Closing Speed: Optional with operator for inspection and adjustment.
3. Stored-Energy Mechanism.
4. Operation counter.

E. Operator Display: Located on the face of the circuit breaker.

1. Electrical operation buttons to open and close the circuit breaker. Provide a clear lockable cover over the buttons.
2. Indicating Lights: To indicate circuit breaker is open or closed. An energized or hot condition shall be indicated by a red light. The de-energized, open, and safe condition shall be indicated by a green light.
3. Provide a "charged-not OK to close" indicator when closing springs are charged but circuit breaker is not ready to close.

F. Overcurrent Protective Tripping: Microprocessor-based, programmable, time-current shaping adjustments; complete with current transformers and sensors and the following features:

1. Programmable functions independent of each other in both action and adjustment.

a. Long-time setting.
b. Long-time-delay with selectable I2T or I4T curve shaping.
c. Short-time setting.
d. Short-time-delay with flat or selectable I2T curve shaping.
e. Instantaneous trip.

2. Field-adjustable, time-current characteristics.
3. Current Adjustability: Dial settings and rating plugs on trip units, or sensors on circuit breakers, or a combination of these methods.
4. Three bands, minimum, for long-time- and short-time-delay functions; marked "minimum," "intermediate," and "maximum."
5. Pickup Points:

a. Five minimum, for long-time- and short-time-trip functions. Equip short-time-trip function for switchable I-squared-T operation.

b. Five minimum, for instantaneous-trip functions.

G. Ground-Fault Protection:

1. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup.
2. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.
3. Test Form: Provide each ground-fault relay with information sheets describing system-testing instructions, and with a test form; comply with UL 1558.

H. Undervoltage Trip Devices: Instantaneous, with adjustable pickup voltage.

I. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.

J. Metering:

1. Accuracy: 1.0 percent of reading, complying with ANSI C12.20.
2. Values shall be rms average over a period of one second.
3. Main circuit breakers shall include separate microprocessor-based multifunction metering with the following metering functions, 3 phase total and per phase:

a. Amperes (A) phase & neutral, Volts (V) Phase & Line, Power readings (KVA, KVAR, KW, KWH and PF).
b. Demand Logging for KWH, KVARH, KVA, KW, KVAR average, Max daily and monthly.
c. Voltage Total Harmonic Distortion (VTHD) for each phase.
d. Current Total Harmonic Distortion (ITHD) for each phase.

K. Feeder circuit breakers; Amperes A, phase & neutral.

L. Auxiliary Contacts:

1. Contacts and switches required for normal circuit-breaker operation, sufficient for interlocking and remote indication of circuit-breaker position.
2. Spare auxiliary switches, at least two, unless otherwise indicated. Each switch shall consist of two Type A and two Type B contacts wired through secondary disconnect devices to a terminal block in stationary circuit-breaker compartment.

M. Padlocking Provisions: For installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.

2.6 TVSS, SPD SURGE SUPPRESSION

A. Surge Suppression: Factory installed as an integral part of low-voltage switchgear, complying with UL 1449 SPD, Type 1, with the following features and accessories:

1. Integral disconnect switch.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 5-A 250-V ac, one NO and one NC, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter.

2.7 CONTROL POWER SUPPLY, 120-V AC

A. Control Power Transformer: Supply 120-V control circuits through dry-type control power transformers, include secondary disconnect devices.

1. Place transformers larger than 3 kVA in separate compartments at the bottom of the vertical section, including the related primary and secondary fuses.
2. Two control power transformers in separate compartments with necessary interlocking relays; each transformer connected to line side of associated main circuit breaker.

    a. Secondary windings connected through relay(s) to control bus to affect an automatic transfer scheme.

    b. Secondary windings connected through an internal automatic transfer switch to switchgear control power bus.

3. Control Power Fuses: Primary and secondary fuses provide current-limiting and overload protection.

2.8 INSTRUMENTATION AND CONTROL

A. Power Distribution Equipment shall be web enabled, direct connected to the Local Area Network (LAN) or Intranet.

B. Ethernet Connectivity:

1. Install a multipoint, RS-485 Modbus serial communications network within the switchgear to interconnect all breaker trip units, protective relays, drives, and metering devices equipped with communications.
2. Serial communications network shall be wired to an Ethernet gateway in the switchgear. Gateway shall be web enabled, with integral network port and embedded web server with factory-configured firmware and HTML-formatted web pages for viewing of power monitoring and equipment status information from switchgear devices equipped with digital communication ports.

3. LAN shall consist of a multipoint, RS-485 Modbus serial communication network to interconnect all breaker trip units, protective relays, drives, and metering devices equipped with communications. Serial communication network shall be connected to Ethernet server that functions as a gateway and server, providing data access via Ethernet Modbus LAN.
4. Server Configuration:

    a. Initial network parameters set using a standard web browser. Connect via a local operator interface, or an RJ-45 port accessible from front of equipment.
    b. Network server shall be factory programmed with embedded HTML-formatted web pages that are user configurable and that provide detailed communication diagnostic information for serial and Ethernet ports as status of RS-485 network; with internal memory management information pages for viewing using a standard web browser.
    c. Password-protected login, with password administration accessible from the LAN using a standard web browser.
    d. Operating Software: Suitable for local access; firewall protected.

5. All serial communications devices within the equipment shall be addressed at the factory and tested.

C. Instrument Transformers: Comply with IEEE C57.13. Instrument transformers may not be used to power space conditioning equipment associated with outdoor switchgear, of for power to convenience receptacles and lighting.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C12.11 maximum ratio error is +/-0.3 % with burdens of W, X, and Y.
2. Current Transformers: Burden and Accuracy class suitable for connected relays, meters, and instruments.

2.9 ACCESSORIES

A. Floor running portable circuit breaker lifter with transfer truck and manual lifting mechanism - Include one per electrical room containing LV Switchgear.

B. Remote racking device for breaker racking and operation.

2.10 IDENTIFICATION

A. Compartment Nameplates: Engraved, laminated-acrylic, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.

B. Arc-Flash Warning Labels:

1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis."

Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. The switchgear shall be installed by the electrical contractor.

B. Install switchgear according to NECA 400 and manufacturer's written instructions.

C. Install switchgear assembly on concrete bases, where indicated on Project Drawings.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

3.3 CONCRETE BASES

A. Coordinate size and location of concrete bases, where indicated on Project Drawings.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems", and concrete materials and installation requirements are specified in Division 03 Section "Cast-in Place Concrete."

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

1. Phase identification shall be A-B-C, left to right, front to back, top to bottom as viewed from the front.

3.5 WIRING INSTALLATION

A. Install wiring according to Division 26 Sections "600 Volt Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

3.6 CONNECTIONS

A. Connect wiring according to Division 26 Section "600 Volt Electrical Power Conductors and Cables."

B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.

C. Raceway or cable tray installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of raceway or cable tray, fittings, and specialties.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Standard. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:

    a. Switchgear.
    b. Circuit breakers.
    c. Protective relays.
    d. Instrument transformers.
    e. Metering and instrumentation.
    f. Ground-fault systems.
    g. Battery systems.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.

1. Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Perform an additional follow-up infrared scan of each switchgear, one at 4 months and the other at 11 months after date of Substantial Completion.
3. Prepare a certified report identifying switchgear checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.8 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics as indicated.

3.9 LABELING

A. On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date and responsible organization and person.

3.10 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 26 23 00

SECTION 26 24 16

600 VOLT PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: Include in emergency, operation, and maintenance manuals. In addition to items specified in Division 0 Section "Operation and Maintenance Data", include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.6 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction

period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner's Representative no fewer than ten days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without written permission from Owner's Representative.
3. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations (office areas): UL 50, NEMA 250, Type 1.
    b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids (process locations; warehouse, packaging, dry storage): UL 50, NEMA 250, Type 12.
    c. Outdoor Locations: UL 50, NEMA 250, Type 3R.
    d. Wash-Down Areas: UL 50, NEMA 250, Type 4X, stainless steel.

e. Other Wet or Damp Indoor Locations: UL 50, NEMA 250, Type 4X, stainless steel.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Same finish as panels and trim.

5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

B. Incoming Mains Location: As indicated on drawings.

C. Phase, Neutral, and Ground Buses:

1. Material: Copper.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus, when indicated on drawings: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus, when indicated on Project drawings: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Copper.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs, when indicated on drawings: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Extra-Capacity Neutral Lugs, when indicated on drawings: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Rating as indicated.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, UL 67, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only, as indicated on drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, UL 67, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as indicated on drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet

available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground- fault protection (30-mA trip).
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and manufacturer's written instructions.

B. Floor Mounted Equipment: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems."

1. Install fasteners to connect concrete base to concrete floor. Unless otherwise indicated, install fasteners on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Mount top most breaker handle 78 inches (1980 mm), maximum, above finished floor.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

G. Install filler plates in unused spaces.

H. Provision for future circuits at flush panelboards: Stub four 1-inch (27-mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-mm) empty conduits into raised floor space or below slab not on grade. Comply with conduit requirements specified in Division 26 Section “Raceway and Boxes for Electrical Systems.”

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 CAULKING

A. Comply with requirements in Division 07 for caulking penetrations and junctions of dissimilar materials.

1. Perimeters of enclosures.
2. Fasteners, bolts, anchors, etc.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems.”

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems.”

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems.”

3.5 WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section "600 Volt Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

3.6 CONNECTIONS

A. Raceway or cable tray installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of raceway or cable tray, fittings, and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical process equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of panelboard. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Test and Inspections:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical and mechanical condition.
3. Inspect anchorage, alignment, grounding, and required area clearances.
4. Verify the unit is clean.

5. Verify circuit breaker sizes and types correspond to Project drawings.
6. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit. Refer to NETA Acceptance Testing Specification for acceptable values.
7. Test continuity of each circuit.
8. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

    a. Use an infrared-scanning device designed to measure temperature or detects significant deviations from normal values. Provide documentation of device calibration.
    b. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.
    c. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

C. Panelboards will be considered defective if they do not pass tests and inspections. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each panelboard, attach a dated and signed "Satisfactory Test" label to tested component.

3.10 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

B. Provide final protection and maintain conditions that ensure coatings, finishes, and enclosures are without damage or deterioration at time of Substantial completion.

1. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge suppression units.
4. Wall-box motion sensors.
5. Isolated-ground receptacles.
6. Snap switches and wall-box dimmers.
7. Wall-switch and exterior occupancy sensors.
8. Communications outlets.
9. Pendant cord-connector devices.
10. Cord and plug sets.
11. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

B. Related Sections include the following:

1. Division 26 Section “Enclosed Switches and Circuit Breakers” for receptacle switches.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Manufacturers' packing label warnings and instruction manuals, including labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configuration.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in the pre-approved wiring device list, attached:

1. Appleton (Appleton).
2. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
4. Killark; a division of Cooper Industries, Inc. (Killark)
5. Leviton Mfg. Company Inc. (Leviton).

6. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
7. Watt Stopper (Watt Stopper).

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to those shown on the pre-approved wiring device list.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles: 125 V, 20 A; Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

B. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed -through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles: 125 V, 20 A.

2.4 TVSS RECEPTACLES

A. General Description: Straight blade; Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.

1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

B. Duplex TVSS Convenience Receptacles: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

C. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; Comply with NEMA WD 6 configuration 5-20R.

1. Description: Straight blade, equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles: 125 V, 20 A; Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

B. Isolated-Ground, Single Convenience Receptacles: 125 V, 20 A; Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Description: Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PIN AND SLEEVE DEVICES

A. Description: Watertight, non interchangeable configuration for each voltage and ampacity. Comply with UL489.

2.8 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.9 CORD AND PLUG SETS (EXTENSION CORDS)

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A.

C. Pilot Light Switches, 20 A, Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A, Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.11 HAZARDOUS (CLASSIFIED) LOCATION SWITCHES

A. Comply with NEMA 3 and UL 698.

2.12 COMMUNICATIONS OUTLETS

A. Telephone Outlet: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. TV Outlet: Type F coaxial cable connector.

2.13 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic or 0.035-inch-(1-mm-) thick, satin-finished stainless steel as indicated.
3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.14 POKE-THROUGH ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand; Wiring Devices & Accessories.
3. Square D/ Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold Company (The).

C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.

1. Service Outlet Assembly: Pedestal type with services indicated or Flush type with four simplex receptacles and space for four RJ-45 jacks as indicated.
2. Size: Selected to fit nominal 4-inch (100-mm) cored holes in floor and matched to floor thickness.
3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
4. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.
5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 5e voice and data communication cables.

2.15 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a

complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG

2.16 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: Brown, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange or as specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served on face of wall plate and on conductors inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 16

ENCLOSED SWITCHES AND ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Molded-case circuit breakers (MCCBs).
5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Spare Parts List: Source and current prices of replacement parts and supplies

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than
three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Product selection: Provide enclosed switches and circuit breakers as specified on the contract drawings. Where manufacturer and model information is not provided on the contract drawings, enclosed switches and circuit breakers shall be provided as specified in the following paragraphs of this specification.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

C. Product Selection for Restricted Space: Comply with Owner required clearances, as shown on the drawings.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with the requirements of this specification, provide products by one of the following.
1. Mennekes – this manufacturer required for process equipment disconnects up to 200A.
2. Square D
3. Eaton
4. Hubbell
5. Rockwell Automation

B. Type HD, Heavy Duty(industrial):

1. Single throw.
2. Three pole, unless otherwise indicated.
3. 600-V ac.1200 A and smaller.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with

cover in closed position.

6. Enclosure: In wet/damp production environments the enclosure shall be 304 stainless steel with a 15 degree sloped roof.
7. Rotary style in wet/damp production environments.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Shall be provided for all local disconnect switches that have shielded Variable Frequency Drive cable terminating at the switch. Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac / 24-V dc.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with the requirements of this specification, provide products by one of the following:
1. Mennekes – this manufacturer required for process equipment disconnects up to 200A.
2. Square D
3. Eaton
4. Hubbell
5. Rockwell Automation

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 -V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. In wet/damp production environments the enclosure shall be 304 stainless steel with a 15 degree sloped roof. Provide rotary style, as sizing allows, in wet/damp production environments.

C. Type HD, Heavy Duty, Six Pole, Single Throw 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. In wet/damp production environments the enclosure shall be 304 stainless steel with a 15 degree sloped roof. Provide rotary style, as sizing allows, in wet/damp production environments.

D. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. In wet/damp production environments the enclosure shall be 304 stainless steel with a 15 degree sloped roof.

Provide rotary style, as sizing allows, in wet/damp production environments.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Shall be provided for all local disconnect switches that have shielded Variable Frequency Drive cable terminating at the switch. Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac / 24-V dc.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.4 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with the requirements of this specification, provide products by one of the following:
1. Meltric
2. Mennekes
3. Eaton Cutler Hammer

B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, ampacity as indicated; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, ampacity as indicated; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class J Fuse Kit: Provides rejection of other fuse types when fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac / 24-V dc.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.5 ENCLOSED MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with the requirements of this specification, provide products by one of the following:
1. Eaton Cutler Hammer
2. ABB
3. Square D

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field- adjustable trip setting.

I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field- adjustable settings, 400A and larger:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30- mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to- test feature, internal memory, and shunt trip unit; and three-phase, zero- sequence current transformer/sensor.
5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit- breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location, unless otherwise indicated on the contract drawings.

1. Indoor, Dry and Clean Locations: Metallic, UL 50, NEMA 250, Type 12.
2. Outdoor Locations: UL 50, NEMA 250, Type 3R.
3. Wet/Damp Production, and Wash-Down Production Areas: UL 50, sloped roof, NEMA 250,
   Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: Metallic, UL 50, NEMA 250, Type 4.
5. Indoor Dry Production Locations, and Locations Subject to Dust, Falling Dirt: Metallic, UL 50, NEMA 250, Type 12.

6. Class II Division 1 Hazardous Areas Indicated on Drawings: UL 50, NEMA 250, Type 9.
7. Class II Division 2 Hazardous Areas Indicated on Drawings: UL 50, NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels, in accordance with the NEC and local code requirements.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Comply with mounting and anchoring requirements specified in Division 26 Section 260529 “Hangers and Supports for Electrical Systems." Drawing details and drawing notes included in the contract drawings for mounting of Enclosed Switches and Circuit Breakers take precedence over the requirements of this specification.

D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Wiring:

1. Install wiring between motor-control devices according to Division 26 Section "600 Volt Electrical Power Conductors and Cables." Comply with NFPA 70 and NECA 1.
2. Bundle, train, and support wiring in enclosures.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with an engraved nameplate. Label format shall be agreed upon, and approved, by the Owner

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Verify correct phase barrier installation.
h. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase- to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase- to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600- V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation.

Insulation resistance values shall be no less than two megohms.

e. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Field Quality Control Reports: Prepare test and inspection reports and submit an electronic copy (PDF format) to the Owner upon completion. Include the following information:

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

F. Cleaning: On completion of installation, inspect interior and exterior of motor control center. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated on the Drawings and Short Circuit Coordination Study.

END OF SECTION 26 28 16

SECTION 26 32 13

ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged engine-generator sets for emergency or standby power supply with the following features:

1. Gas or Diesel engine.
2. Unit-mounted Remote-mounting cooling system.
3. Unit-mounted Remote-mounting control and monitoring.
4. Performance requirements for sensitive loads.
5. Outdoor enclosure.

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine- generator sets.

1.2 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.
1. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
2. Report of exhaust emissions showing compliance with applicable regulations.
3. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition provide:

1. Installation instructions.
2. Routine maintenance requirements for generator.

F. Spare Parts: Source and current prices of replacement parts and supplies.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASME B15.1.

E. Comply with NFPA 37.

F. Comply with NFPA 110 requirements for Level 2 emergency power supply system.

G. Comply with UL 2200.

H. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver package engine generator individually wrapped for protection and mounted on shipping skids.

Store package engine generator indoors in clean dry space with uniform temperature to prevent condensation. Protect engine generator from exposure to dirt, fumes, water, corrosive substances, and physical damage.

If stored in areas subjected to weather, cover package engine generator to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside enclosures and apply temporary heat according to manufacturer's written instructions to prevent condensation.

1. NECA 404, "Standard for Installing Generator Sets."
2. Follow manufacturer's written instruction for handling equipment. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to enclosure and finish.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability, unless otherwise indicated:

1. Ambient Temperature: - 22 deg F (Minus 30 deg C) to 110 deg F (43 deg C).
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m)

Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner's Representative no fewer than ten days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary electrical service.
3. Do not proceed with interruption of electric service without written permission from Owner's Representative .

1.7 COORDINATION

Coordinate layout and installation of package engine generators and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

Coordinate size and location of concrete bases for package engine generators and remote radiators mounted on grade. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

Coordinate size and location of roof curbs, equipment supports, and roof penetrations for remote radiators. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.
2. Onan/Cummins Power Generation; Industrial Business Group.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated.
2. Output Connections: Three-phase, three or four wire, as indicated.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor,

determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load
current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

2.3 ENGINE

A. Diesel Fuel: Fuel oil, Grade DF-2.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
3. Natural Gas with System:

a. Carburetor.
b. Secondary Gas Regulators: One for each fuel type.
c. Fuel-Shutoff Solenoid Valves: One for each fuel source.
d. Flexible Fuel Connectors: One for each fuel source.

F. Governor: Adjustable isochronous, with speed sensing.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine- generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Muffler/Silencer: Industrial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 12 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 87 dBA or less.

I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

J. Starting System: 12 or 24-V electric, with negative ground, as indicated.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage

regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Day Tank, where indicated: Comply with UL 142, freestanding, factory-fabricated fuel tank assembly, with integral, float-controlled transfer pump and the following features:

1. Containment: Integral rupture basin with a capacity of 150 percent of nominal capacity of day tank.

    a. Leak Detector: Locate in rupture basin and connect to provide audible and visual alarm in the event of day-tank leak.

2. Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 4 hours' operation at 100 percent of rated power output of engine-generator system without being refilled] .
3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25

percent of normal fuel level.

C. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.
2. Capacity: Fuel for eight hours' continuous operation at 100 percent rated power output.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.

10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

G. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.9 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene.

2.10 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each generator, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

B. Provide warning and caution nameplates as required. Labeling requirements specified in Division 26 “Identification for Electrical Systems.”

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Report factory test results within 10 days of completion of test.

2.12 FACTORY FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer, unless indicated otherwise.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.2 DEMONSTRATION

A. Provide a factory-authorized service representative to train Owner's maintenance

personnel to adjust, operate, and maintain packaged engine generators.

3.1 EXAMINATION

Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install packaged engine-generator according to NECA 404 and manufacturers' written installation and alignment instructions and with NFPA 110.

Install package engine generator to provide access, without removing connections or accessories, for periodic maintenance.

Install package engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from package engine generator and components.

3.3 CONCRETE BASES

Coordinate size and location of concrete bases, where indicated on Project Drawings.

Concrete base is specified in Division 26 Section “Hangers and Supports for Electrical Systems”, and concrete materials and installation requirements are specified in Division 03 Section “Cast-in Place Concrete.”

3.4 IDENTIFICATION

Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

1. Phase identification shall be A-B-C, left to right, front to back, top to bottom as viewed from the front.

3.5 WIRING INSTALLATION

Install wiring according to Division 26 Sections "600 Volt Electrical Power Conductors and Cables."

Connect transfer switch to package engine generator and other automatic-control devices where applicable.

Bundle, train, and support wiring in enclosures.

Raceway or cable tray installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of raceway or cable tray, fittings, and specialties.

3.6 CONNECTIONS

Connect fuel, cooling-system, and exhaust-system piping adjacent to package engine generator to allow service and maintenance.

Connect engine exhaust pipe to engine with flexible connector.

Connect fuel piping to engines with a gate valve and union and flexible connector.

Tighten electrical connectors, and terminals according to manufacturer's published torque-tightening values.

Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Owner will engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.
   3. Report results in writing.
C. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.
   1. Use an infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Perform an additional follow-up infrared scan of each termination and connection, one at 4 months and the other at 11 months after date of Substantial Completion.
   3. Prepare a certified report that identifies terminations and connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

3.8 ADJUSTING

Set field-adjustable switches and circuit-breaker trip ranges as indicated or per manufacturer's documentation.

3.9 LABELING

On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date and responsible organization and person.

3.10 CLEANING

On completion of installation, inspect interior and exterior of package engine generator. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 32 13

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections include the following:

1.3 SUBMITTALS

A. Several fixtures have been pre-approved by Owner. Provide submittal data when submitting other than pre-approved fixtures. Submittal data is not required for pre-approved fixtures.

B. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output, and energy-efficiency data for lamps.
5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.

6. Product Information: For foot-candle study computer software programs.

C. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

1. Wiring Diagrams: Power and control wiring.

D. Samples for Verification: For each type interior light. Each sample shall include the following:

1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals, including installation instructions.

G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.6 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: Minimum 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency LED Driver and Self-Powered Exit Sign Batteries: Minimum seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

B. Special Warranty for LED Fixtures. Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for LED Driver: Minimun five years from date of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive and handle fixture in accordance to NECA 502, “Installing Industrial Lighting Systems” and manufacturer’s written instructions.

B. Store in a warm, dry location with uniform temperature. Cover to keep out dust and protect against exposure to fumes, water, corrosive substances, and physical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by, but not limited to, manufacturers specified.

1. Cooper Crouse-Hinds Pauluhn; a division of Cooper Industries
2. Cooper Lighting; a division of Cooper Industries
3. Day-Brite Lighting
4. Holophane
5. Hubbell Lighting, Inc.
6. Lithonia Lighting, Inc.

2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 90 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Plastic Diffusers, Covers, and Globes:

1. Polycarbonate Lighting Diffusers: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.09 inch (2.3 mm) minimum unless different thickness is indicated.
b. UV stabilized.

2.3 EXIT SIGNS

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:
1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.
b. Charger: Fully automatic, solid-state type with sealed transfer relay.
c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory- installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, nickel-cadmium type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures, when indicated on Project Drawings.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

2.5 REQUIREMENTS FOR INDIVIDUAL LIGHTING FIXTURES

A. Fixture Type A1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux SkyRidge 24SR LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Recessed Mount)
4. Nominal Dimensions: 47.9375 in. Long by 23.75 in. Wide.
5. Lamps: LED 4800 Lumens, quantity as indicated on Project Drawings
6. Reflector: Curved
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming

B. Fixture Type B1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Lensed LED Strip Round Lens or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 48 in. Long by 3 in. Wide.

5. Lamps: LED 4700 Lumens, quantity as indicated on Project Drawings
6. Lens: Full Frost - Wide
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Adjustable 48” Stem Set

C. Fixture Type B2L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Lensed LED Strip Round Lens or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 96 in. Long by 3 in. Wide.
5. Lamps: LED 7400 Lumens, quantity as indicated on Project Drawings
6. Lens: Full Frost - Wide
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Adjustable 48” Stem Set

D. Fixture Type C1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Surface and Wall LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Surface/Wall at height indicated on Project Drawings.
4. Nominal Dimensions: 48 in. Long by 4.6875 in. Wide.
5. Lamps: LED 4800 Lumens, quantity as indicated on Project Drawings
6. Lens: Full Frost - Wide
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver

E. Fixture Type C2L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Surface and Wall LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Surface/Wall at height indicated on Project Drawings.
4. Nominal Dimensions: 48 in. Long by 4.6875 in. Wide.
5. Lamps: LED 8000 Lumens, quantity as indicated on Project Drawings
6. Lens: Full Frost - Wide
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver

F. Fixture Type D1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)

4. Nominal Dimensions: 47.125 in. Long by 5.875 in. Wide.
5. Lamps: LED 4000 Lumens, quantity as indicated on Project Drawings
6. Lens: Smooth Frosted
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver

G. Fixture Type D2L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 47.125 in. Long by 5.875 in. Wide.
5. Lamps: LED 8000 Lumens, quantity as indicated on Project Drawings
6. Lens: Smooth Frosted
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver

H. Fixture Type F41L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial Refrigerated Case LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 49.8125 in. Long by 7 in. Wide.
5. Lamps: LED 4000 Lumens, quantity as indicated on Project Drawings
6. Lens: Internal Prismatic Lens/100% DR High Impact Additive
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Wet Location Label

I. Fixture Type F42L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial Refrigerated Case LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 49.8125 in. Long by 7 in. Wide.
5. Lamps: LED 8000 Lumens, quantity as indicated on Project Drawings
6. Lens: Internal Prismatic Lens/100% DR High Impact Additive
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Wet Location Label

J. Fixture Type F81L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial Refrigerated Case LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 97.8125 in. Long by 7 in. Wide.
5. Lamps: LED 9000 Lumens, quantity as indicated on Project Drawings
6. Lens: Internal Prismatic Lens/100% DR High Impact Additive
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Wet Location Label

K. Fixture Type F82L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial Refrigerated Case LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 97.8125 in. Long by 7 in. Wide.
5. Lamps: LED 16000 Lumens, quantity as indicated on Project Drawings
6. Lens: Internal Prismatic Lens/100% DR High Impact Additive
7. CCT/CRL: 4000K, 80CRI
8. Two (2) 0-10V Dimming Drivers
9. Wet Location Label

L. Fixture Type G1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Benchmark High Bay LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 17.75 in. Wide by 15.5 in. Tall.
5. Lamps: LED 12000 Lumens, quantity as indicated on Project Drawings
6. Distribution/Shielding: Medium Clear
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. 6 ft Cord with NEMA Plug (NEMA L7-15P)
10. Motion Sensor Installed; All fixtures except for where indicated on Project Drawings

M. Fixture Type G2L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Benchmark High Bay LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 17.75 in. Wide by 15.5 in. Tall.
5. Lamps: LED 36000 Lumens, quantity as indicated on Project Drawings
6. Distribution/Shielding: Medium Clear

7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. 6 ft Cord with NEMA Plug (NEMA L7-15P)
10. Motion Sensor Installed; All fixtures except for where indicated on Project Drawings

N. Fixture Type G3L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Benchmark High Bay LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 26.875 in. Wide by 15.9375 in. Tall.
5. Lamps: LED 70000 Lumens, quantity as indicated on Project Drawings
6. Distribution/Shielding: Narrow Clear
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. 6 ft. Cord with NEMA Plug (NEMA L7-15P)
10. Motion Sensor Installed; All fixtures except for where indicated on Project Drawings

O. Fixture Type GH1L:

1. Basis-of-Design Product: Hazlux Hazardous Location High Bay LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 24 in. Wide by 12.2 in. Tall.
5. Lamps: LED 16200 Lumens, quantity as indicated on Project Drawings
6. Optic: Oval, 26º x 108º
7. Color: Cool White
8. CCT/CRL: 5000K, 80CRI

P. Fixture Type GH2L:

1. Basis-of-Design Product: Hazlux Hazardous Location High Bay LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 24 in. Wide by 12.2 in. Tall.
5. Lamps: LED 31400 Lumens, quantity as indicated on Project Drawings
6. Optic: Oval, 26º x 108º
7. Color: Cool White
8. CCT/CRL: 5000K, 80CRI

Q. Fixture Type H1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Halo Commercial LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.

3. Mounting: Recessed at height indicated on Project Drawings.
4. Nominal Dimensions (Housing Frame): 26.375 in. Long by 8.9375 in. Wide.
5. Lamps: LED 2000 Lumens, quantity as indicated on Project Drawings
6. Reflector: 4 in. Conical
7. Finish: Semi-specular Clear
8. CCT/CRL: 4000K, 80CRI
9. 0-10V Dimming Driver

R. Fixture Type JH:

1. Basis-of-Design Product: Solas Ray Hazardous Area Linear LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Adjustable Bracket for Wall & Ceiling)
4. Nominal Dimensions (Housing Frame): 46.3 in. Long by 6.93 in. Wide.
5. Lamps: LED 6000 Lumens, quantity as indicated on Project Drawings
6. Lens: Flat Glass (Tempered)
7. CCT/CRL: 5000K, 80CRI

S. Fixture Type JL:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 47.125 in. Long by 5.875 in. Wide.
5. Lamps: LED 6000 Lumens, quantity as indicated on Project Drawings
6. Lens: Smooth Frosted
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver

T. Fixture Type JS:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Vaportite Industrial LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 47.125 in. Long by 5.875 in. Wide.
5. Lamps: LED 6000 Lumens, quantity as indicated on Project Drawings
6. Lens: Smooth Frosted
7. CCT/CRL: 4000K, 80CRI
8. 0-10V Dimming Driver
9. Stainless Steel Latches with Tamper-proof Screws
10. Stainless Steel Surface Bracket (2 per kit)

U. Fixture Type K1L:

1. Basis-of-Design Product: Fail-Safe Hose Down Fixture LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 49.25 in. Long by 6.75 in. Diameter.
5. Lamps: LED 4601 Lumens, quantity as indicated on Project Drawings
6. Illumination Level: Low
7. Color Temp: 4000K
8. Internal Diffuser: Opal Polycarbonate
9. Electronic Driver, 1 circuit, Non-dimming

V. Fixture Type K2L:

1. Basis-of-Design Product: Fail-Safe Hose Down Fixture LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 49.25 in. Long by 6.75 in. Diameter.
5. Lamps: LED 7399 Lumens, quantity as indicated on Project Drawings
6. Illumination Level: High
7. Color Temp: 4000K
8. Internal Diffuser: Opal Polycarbonate
9. Electronic Driver, 1 circuit, Non-dimming

W. Fixture Type KH:

1. Basis-of-Design Product: Solas Ray Hazardous Area Linear LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Adjustable Bracket for Wall & Ceiling)
4. Nominal Dimensions (Housing Frame): 46.3 in. Long by 6.93 in. Wide.
5. Lamps: LED 12000 Lumens, quantity as indicated on Project Drawings
6. Lens: Flat Glass (Tempered)
7. CCT/CRL: 5000K, 80CRI

X. Fixture Type N1L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Linear High Bay Lensed LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 23.75 in. Long by 12.625 in. Wide.
5. Lamps: LED 12000 Lumens, quantity as indicated on Project Drawings
6. Lensing: Diffused Lens
7. CCT/CRI: 80CRI/4000K
8. 0-10V Dimming Driver

9. Motion Sensor incorporated; All fixtures except for where indicated on Project Drawings
10. 12 ft. white cord, 18/3, with 277V, 15A NEMA twist-lock plug

Y. Fixture Type N2L:

1. Basis-of-Design Product: Cooper Crouse-Hinds Metalux Linear High Bay Lensed LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Pendant Mount)
4. Nominal Dimensions: 45.875 in. Long by 12.625 in. Wide.
5. Lamps: LED 36000 Lumens, quantity as indicated on Project Drawings
6. Lensing: Diffused Lens
7. CCT/CRI: 80CRI/4000K
8. 0-10V Dimming Driver
9. Motion Sensor incorporated; All fixtures except for where indicated on Project Drawings
10. 12 ft. white cord, 18/3, with 277V, 15A NEMA twist-lock plug

Z. Fixture Type PL:

1. Basis-of-Design Product: Cooper Crouse-Hinds Vapor Tight Floodlight LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Wall at height indicated on Project Drawings.
4. Nominal Dimensions: 5.5 In Wide by 9 in. Tall.
5. Lamps: LED 1450 Lumens, quantity as indicated on Project Drawings
6. Lens: Frosted Glass
7. CCT/CRI: 80CRI/3500K

AA. Fixture Type SL:

1. Basis-of-Design Product: Killark Certilite V Hazardous Location LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)
4. Nominal Dimensions: 17.03 in. Tall by 18.25 in. Diameter.
5. Lamps: LED 7000 Lumens, quantity as indicated on Project Drawings
6. Optic: Polycarbonate Shielded Enclosed Refector
7. CCT/CRI: 70CRI/5000K

BB. Fixture Type TL:

1. Basis-of-Design Product: Killark Certilite V Hazardous Location LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface/Pendant Mount)

4. Nominal Dimensions: 17.03 in. Tall by 18.25 in. Diameter.
5. Lamps: LED 15000 Lumens, quantity as indicated on Project Drawings
6. Optic: Polycarbonate Shielded Enclosed Refector
7. CCT/CRI: 70CRI/5000K

CC. Fixture Type X1:

1. Basis-of-Design Product: Cooper Crouse-Hinds LED Polycarbonate Exit or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Wall at height indicated on Project Drawings.
4. Nominal Dimensions: 13 in. Wide by 7.5 in. High.
5. Lamps: LED, quantity as indicated on Project Drawings
6. Self Powered Option

DD. Fixture Type Y:

1. Basis-of-Design Product: McGraw-Edison Surface Canopy LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface Mount)
4. Nominal Dimensions: 18.375 in. Diameter by 4.8125 In High.
5. Lamps: LED 10000 Lumens, quantity as indicated on Project Drawings
6. Distribution: Medium
7. CCT/CRI: 70CRI/4000K
8. 0-10V Dimming Driver

EE. Fixture Type Z:

1. Basis-of-Design Product: McGraw-Edison Surface Canopy LED or a comparable product.
2. Voltage: 277V ac, as indicated on Project Drawings.
3. Mounting: Suspended at height indicated on Project Drawings. (Surface Mount)
4. Nominal Dimensions: 18.375 in. Diameter by 4.8125 In High.
5. Lamps: LED 5500 Lumens, quantity as indicated on Project Drawings
6. Distribution: Medium
7. CCT/CRI: 70CRI/4000K
8. 0-10V Dimming Driver

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lighting assembly according to NECA 502 and manufacturer’s written instructions.

B. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

3.2 CONNECTIONS

A. Connect wiring according to Division 26 Section "600 Volt Electrical Power Conductors and Cables."

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 ADJUSTING

A. Adjust aimable lighting fixtures to provide required light intensities.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of lighting fixtures. Clean lenses and differs, remove paint splatters and other spots. Use methods and materials recommended by manufacturer.

B. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 26 51 00

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.01 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of pole mounted luminaries, controls, poles and supports.

1.02 RELATED WORK

A. Section 26 01 35, Electrical General.

B. Section 26 05 33, Electrical Raceways: Conduits, fittings, and boxes for raceway systems.

C. Section 26 05 19, 600 volt electrical power conductors and cables.

D. Section 26 05 26, Grounding and Bonding: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.03 SUBMITTALS

A. Submit in accordance with Sections 01 33 00 SUBMITTAL PROCEDURES and 26 01 35, Electrical General.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

2. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, poles, luminaries, lamps and controls.

3. Point by point illumination level for all alternate luminaires from those shown on the light fixture schedule. Illumination data shall comply with IESNA Handbook for all applicable areas of use.

C. Manuals: Two weeks prior to final inspection, submit four copies of operating and maintenance manuals to the Electrical Engineer. Include technical data sheets, wiring and connection diagrams, and information for ordering replacement parts.

D. Certifications: Two weeks prior to final inspection, submit four copies of the following to the Electrical Engineer:

1. Certification that the materials are in accordance with the drawings and specifications.

2. Certification, by the Contractor, that the complete installation has been properly installed and tested.

1.04 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

B. American Society for Testing and Materials (ASTM):

A123/A123M-2001 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

A153/A153M-2001 Zinc Coating (Hot-Dip) on Iron and Steel Hardware – AASHTO No.: M232

1. American Concrete Institute (ACI):

318-2002.....Building Code Requirements for Structural Concrete

2. American National Standards Institute (ANSI):

C81.61-1990.....Electrical Lamp Bases

C136:31- 2001…….LED Luminaires for 100,000 hours

3. Illuminating Engineering Society of North America (IESNA)

HB-9-2000.....Lighting Handbook

4. National Electrical Manufacturers Association (NEMA):

C78.42-2001.....Electric Lamps – Guidelines for High-Pressure Sodium Lamps

C82.4-1992.....Ballasts for High-Intensity-Discharge Lamps (Multiple-Supply Type)

ICS 2-2000 .....Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

ICS 6-1993 .....Industrial Control and Systems Enclosures

5. National Fire Protection Association (NFPA):

70-2005.....National Electrical Code (NEC)

6. Underwriters Laboratories, Inc. (UL):

496-1996.....Edison-Base Lamp holders

773A-1995.....Non-industrial Photoelectric Switches for Lighting Control

1029-1994.....High-Intensity-Discharge Lamp Ballasts

1598-2000.....Luminaries

1.05 Delivery, Storage, and Handling

A. Steel Poles: Do not store poles on ground. Store poles so they are at least (one foot) above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be in accordance with NEC, UL, ANSI, and as shown on the drawings and specified.

2.02 POLES

A. General:

1. Poles shall be square steel, as shown on the drawings, and as specified. Finish shall be as specified on the drawings.

2. The pole and arm assembly shall be designed for wind loading of 100 miles per hour, with an additional 30 percent gust factor, supporting luminaire(s) having the effective projected areas indicated. The effective projected area of the pole shall be applied at the height of the pole base as shown on the drawings.

3. Poles shall be anchor-bolt type designed for mounting on top of extruded concrete columns for supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5

inches. Handhole cover shall be secured by tamper proof stainless steel captive screws.

4. Provide a steel grounding stud opposite hand hole openings.

5. Provide a base cover matching the pole in material and color to conceal the mounting hardware, pole-base welds to anchor bolts.

6. Hardware: All necessary hardware shall be 300 series stainless steel.

B. Types:

1. Steel: Provide steel poles, primed and painted, corrosion resistant. Poles shall be seamless extruded or spun seamless type. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Provide base covers for steel poles. Provide GRSC conduit in concrete column for power supply to upper deck pole mounted luminaires. Bond conduit to column rebars and stub out under upper deck concrete floor slab.

2.03 FOUNDATIONS FOR POLES

A. Refer to Division 3 for concrete specifications.

2.04 LUMINAIRES

A. UL 1598, ANSI C136.17 and CSA-C22.2 number 250 for 40C. Luminaries shall be weatherproof, heavy duty, outdoor types designed for efficient light utilization, adequate dissipation of lamp and ballast heat and safe cleaning and re lamping Luminaire meets EMI compliance per FCC Title 47 CFR Part 15, Class A.

B. IESNA HB-9 and RP-8 light distribution pattern types shall be as shown on the drawings.

1. Incorporate ballasts in the luminaire housing except where otherwise shown on the drawings.

2. Lenses shall be frame-mounted heat-resistant, borosilicate glass, prismatic refractors. Attach the frame to the luminaire housing by hinges or chain.

3. Lamp sockets for high intensity discharge (H.I.D) fixture shall have locking type porcelain enclosures in conformance to the applicable requirements of ANSI C81.61 and UL 496.

4. Pre-wire internal components to terminal strips at the factory.

5. Bracket mounted luminaries shall have leveling provisions and clamp type adjustable slip-fitters with locking screws.

6. Materials shall be rustproof. Latches and fittings shall be non-ferrous metal.

C. Lamps:

1. Install the proper lamps in every luminaire installed and every luminaire relocated or reinstalled.

2. Lamps to be general-service, outdoor lighting types.

3. Metal-Halide Lamps:

a. 70 Watt: NEMA C78.1381.

b. 175 Watt: NEMA C78.1377.

c. 250 Watt: NEMA C78.1378.

4. LED lamps shall have zero uplight for reduced light pollution, with glass optics for minimal dirt depreciation and limited discoloration. Minimal CRI shall be 70; LED color temperature shall range from 4000K to 6000K. LED Drivers shall be solid state type rated for 50,000hours with built in surge protection device designed to meet ANSI/IEEE C62.41-2002 for category C high.

D. High Intensity Discharge Ballasts:

1. For low voltage systems, the ballasts shall be the high efficiency, high power factor, copper-wound constant wattage type and shall meet the requirements of UL 1029 and NEMA C82.4.

a. Ballasts shall operate the discharge lamp of the type, wattage, and voltage shown on the drawings.

b. Ballasts shall have individual overcurrent protection (inline fuse holder) as recommended by the ballast manufacturer.

c. Ballasts shall be capable of providing reliable starting of the lamps at minus 30 degrees C.

d. Open-circuit operation shall not reduce the average life.

2. Locate protective devices for ballasts to be accessible if the devices are not integral with ballasts.

3. Each ballast shall operate not more than one lamp except where otherwise shown on the drawings.

E. Controls:

1. Each Lighting System:

a. Shall be controlled by one of the following methods as shown for each system on the drawings:

i. A photocell to act as the pilot device. The photocell shall be the type which fails safe to the closed position meeting UL 773 or 773A.

ii. The pilot devices shall control the power circuit through the contractor or relay as shown on the drawings.

b. Mount and connect photocells and time clocks as shown on the drawings.

c. Photocells shall have the following features:

i. Quick-response, cadmium-sulfide type.

ii. A 15 to 30 second, built-in time delay to prevent response to momentary lightning flashes, car headlights or cloud movements.

iii. Energizes the system when the north sky light decreases to approximately 1.5 foot-candles, and maintains the system energized until the north sky light increases to approximately 3 to 5 foot candles.

d. Time clocks shall have the following features:

i. A 24-hour astronomic dial, motor-driven.

ii. A spring-actuated, reserve power mechanism for operating the timer during electrical power failures and that automatically winds the spring when the electrical power is restored.

e. The arrangement and method of control and the control devices shall be as shown on the drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install lighting in accordance with the NEC, as shown on the drawings, and in accordance with manufacturer's recommendations.

B. Steel Poles:

1. Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 1.57 rad 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

2. After the poles have been installed, shimmed and plumbed, grout the spaces between the pole bases and the concrete base with non-shrink concrete grout material. Provide a copper tube, of not less than 3/8-inch inside diameter, through the grout tight to the top of the concrete base for moisture weeping.

C. Foundation Excavation: No foundation excavation is necessary. Pole bases will be poured atop of the extruded concrete columns.

D. Photocell Switch Aiming: Aim switch facing north according to manufacturer's recommendations. Set adjustable window slide for proper foot-candles photocell turn-on.

3.02 GROUNDING

A. Ground non-current-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 260526, Grounding and Bonding. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable and listed for this purpose.

END OF SECTION 26 56 00

SECTION 27 13 00

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

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

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. Ethernet cable.
3. 50/125-micrometer, OM4 optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

B. Related Sections:

1. Section 27 15 00 "Communications Horizontal Cabling".

1.2 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

1.3 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the

telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-C.2, when tested according to test procedures of this standard.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Submit appropriate cut sheets for all products, hardware and cabling, if requested.

a. For Ethernet cable, include the following installation data for each type used:

1) Nominal OD.
2) Minimum bending radius.
3) Maximum pulling tension.

b. For coaxial cable, include the following installation data for each type used:

1) Nominal OD.
2) Minimum bending radius.
3) Maximum pulling tension.

c. For fiber cable, include the following installation data for each type used:

1) Nominal OD.
2) Minimum bending radius.
3) Maximum pulling tension.

2. The telecommunications contractors must receive approval from the owners on all substitutions of material. No substituted materials can be installed unless there is written approval from the owner.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. Cabling administration drawings and printouts.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer qualified layout technician, installation supervisor, and field inspector.

1.7 CLOSEOUT SUBMITTALS

A. Electronic copy of test results. (on USB)

B. As-Built drawings (on USB)

1.8 QUALITY ASSURANCE

A. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

B. Grounding: Comply with ANSI-J-STD-607-A.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set and provide test results on attenuation, polarity and cable length.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in closeout data.

3. Test each pair of Ethernet cable for open and short circuits and provide test results.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.0 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.

2. Lacing bars, spools, J-hooks, and D-rings.

3. Straps and other devices.

C. Cable Trays:

1. Refer to Division 26 Specification,

2.1 BACKBOARDS

A. Backboards: Plywood, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 061000 "Rough Carpentry" for plywood backing panels.

2.2 ETHERNET CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.

2. Lapp Corp.

3. LUTZE Inc.

4. Mohawk; a division of Belden CDT.

5. Panduit Corp.

B. Description: 100-ohm, 100 pair Ethernet, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-C.2 for performance specifications.

3. Comply with TIA/EIA-568-C.2, Category 3.

4. Comply with ANSI/TIA 568-C.0 for Mechanical, Ingress, Climate, and Electromagnetic (MICE) ratings.

5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

   a. Communications, General Purpose: Type CM, or CMG, or MPP, CMP, MPR, CMR, MP, or MPG.

   b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.

   c. Communications, Riser Rated: Type CMR, or MPP, CMP, or MPR, complying with UL 1666.

   d. Communications, Limited Purpose: Type CMX, or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.

   e. Multipurpose: Type MP or MPG, or MPP or MPR.

   f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

   g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

   h. Communications, Power Limited Tray Cable: Type PLTC, complying with UL 13.

2.3 ETHERNET CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Allen Bradley.

   2. Panduit Corp.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 3. Provide blocks for the number of cables terminated on the block. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

2.4 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden

2. Corning Cable Systems.

3. Panduit Corp.

B. Description: Multimode, 50/125-micrometer (OM4), 24-fiber, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with TIA/EIA-492AAAA-B for detailed specifications.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. General Purpose, Nonconductive: Type OFN or OFNG, or OFNR, OFNP.

b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.

d. General Purpose, Conductive: Type OFC or OFCG, or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.

e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.

f. Riser Rated, Conductive: Type OFCR, or OFNR, OFCP, or OFNP, complying with UL 1666.

5. Conductive cable shall be aluminum armored type.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

8. Jacket:

   a. Jacket Color: Violet for 50/125-micrometer cable.

   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.

   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

C. 9/125 MICROMETER SINGLE-MODE, INSIDE PLANT OPTICAL FIBER CABLE (OS2)

1. Description: Single mode, 9/125-micrometer, 12 fibers, single loose tube, optical fiber cable.

2. Description: Single mode, 9/125-micrometer, 24 fibers, stranded loose tube, optical fiber cable.

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Belden

   b. Corning Cable Systems.

   c. Panduit Corp.

4. Conductive cable shall be aluminum armored type.

5. Maximum Attenuation: 0.5 dB/km at 1310 nm; 0.5 dB/km at 1550 nm.

6. Jacket:

   a. Jacket Color: Yellow
   b. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
   c. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

7. Comply with TIA-492CAAB for detailed specifications.

8. Comply with TIA-568-C.3 for performance specifications.

9. Comply with ICEA S-83-596 for mechanical properties.

10. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

b. Plenum Rated, Nonconductive: Type OFNP in listed plenum communications raceway.

c. Plenum Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit.

d. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262; Type OFNP in listed plenum communications raceway; or Type OFNP, or Type OFNR in metallic conduit.

e. Riser Rated, Nonconductive: Type OFNR or Type OFNP, complying with UL 1666.

f. Riser Rated, Nonconductive: Type OFNP or Type OFNR in listed riser or plenum communications raceway.

g. Riser Rated, Nonconductive: Type OFNP, or Type OFNR in metallic conduit installed per NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

2.5 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Corning Cable Systems.

2. Panduit Corp.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden CDT Inc.; Electronics Division.
3. Coleman Cable, Inc.
4. CommScope, Inc.
5. Draka USA.

B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.
4. Jacketed with sunlight-resistant, black PVC or PE.
5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG59/U: NFPA 70, Type CATVR.

1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.
2. Gas-injected, foam-PE insulation.
3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.
4. Color-coded PVC jacket.

E. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.

4. Suitable for indoor installations.

F. RG59/U: NFPA 70, Type CATV.

1. No. **20** AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.

3. PVC jacket.

G. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.

2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.

3. Copolymer jacket.

H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV, or CATVP or CATVR.

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

3. CATV Riser Rated: Type CATVR, or CATVP, CATVR, or CATV, complying with UL 1666.

4. CATV Limited Rating: Type CATVX.

2.7 COAXIAL CABLE HARDWARE

A. 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:

1. Aim Electronics; a brand of Emerson Electric Co.

2. Leviton Voice & Data Division.

3. Siemon Co. (The).

B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.8 GROUNDING

A. Comply with ANSI-J-STD-607-A.

2.9 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-C.2.

C. Factory test Ethernet cables according to TIA/EIA-568-C.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports. (Coordinate tests and inspection with section 3.7)

PART 3 - EXECUTION

3.0 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Cable Trays: Refer to Division 26 Specification.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Drawings and indicate general arrangement of pathways and fittings.

C. Where conduit is required install manufactured conduit sweeps and long-radius elbows whenever possible.

D. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (76 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-C.2.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. Ethernet Cable Installation:

1. Comply with TIA/EIA-568-C.2.

2. Do not untwist Ethernet cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-C.2.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

3. The General Contractor should always confirm with the plant location which fiber is being used currently, (OM4 or OS2). OS2 is always used in place of OM4 in distances greater than 550 meters.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend Ethernet cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

H. Group connecting hardware for cables into separate logical fields.

I. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open copper communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between copper communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between copper communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between copper communications cables and electrical motors and transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between copper communications cables and fluorescent fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

C. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections: (Coordinate tests and inspection with section 2.10).

1. Visually inspect Ethernet and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-C.2.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test Ethernet copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.2. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-C.2.

B. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Field Quality Control Reports: Prepare test and inspection reports and submit an electronic copy (PDF format) to the Owner upon completion.

END OF SECTION 27 13 00

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	Submittals
1.3	Quality Assurance
1.4	Field Conditions
2.1	Equipment
3.1	Clearing and Grubbing
3.2	Timber
3.3	Disposal of Cleared and Grubbed Materials
3.4	Discing

A. SCOPE

1. Work included under this section includes providing all labor, equipment, and materials necessary to clear wooded areas and dispose of cleared materials in a legal manner.

2. Clearing and grubbing includes, but is not limited to removal from the project lands of trees, stumps, roots, brush, structures, abandoned utilities, trash, debris, and all other materials found on or near the surface of the ground in the construction area and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated. Precautionary measures to prevent damage to existing features to remain is part of the work.

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. Field Quality Control Submittals

a. Photographs and/or videotape sufficiently detailed of existing conditions within the limits of construction and of trees and plantings, construction, and site improvements of the adjoining area that might be misconstrued as damage caused by site clearing.

1.3 QUALITY ASSURANCE

A. Comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state or federal authorities having jurisdiction over the project. Obtain all required permits for construction operations.

B. Obtain pre-approval from the local authority having jurisdiction for open burning.

1.4 FIELD CONDITIONS

A. Existing Conditions

1. The area to be cleared and grubbed is shown schematically on the drawings. Minimize clearing of existing trees to maintain a natural buffer around the proposed work.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Furnish equipment with operators of the type normally used in clearing and grubbing operations including, but not limited to tractors, trucks, loaders, root rakes, and burning equipment.

B. Furnish discing equipment capable of plowing the soil to a depth of 6 inches twice in a single pass.

PART 3 - EXECUTION

3.1 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.

B. Remove obstructions, trees, shrubs, grass, 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 CUMMING UTILITIES.

2. Grind stumps and remove roots, obstructions, and debris extending to a depth of eighteen (18) inches below exposed sub-grade.

3. Use only hand methods for grubbing within tree protection zone.

4. Chip removed tree branches and stockpile in approved areas or dispose of offsite, as directed by CUMMING UTILITIES.

C. Grub and remove stumps and roots to a depth not less than two feet (2') 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 CUMMING UTILITIES. Place fill material in horizontal layers or lifts, not exceeding a loose depth of eight (8) inches, and compact each layer to 85% 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. All Contractors should be aware that the Georgia Environmental Protection Division has issued a burning ban for thirteen (13) Metro Atlanta Counties, including Forsyth. The ban went into effect in 1996 and shall continue each year from May 1 through September 30. This ban should be considered when bidding projects that require clearing and debris removal. It is the Contractor's responsibility to remove all construction debris from the jobsite. Any costs incurred as a result of the burning ban are the sole responsibility of the Contractor.

3.2 TIMBER

A. Salvage all timber within the 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.

3.3 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 disposed of in areas approved by CUMMING UTILITIES.

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.

3.4 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.

END OF SECTION 31 11 00

SECTION 31 13 11

TEMPORARY FENCING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Tree Save Barrier
3.1	Temporary Fencing

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Clearing and Grubbing (31 11 00).
2. Excavation and Fill (31 23 00).
3. Wetlands Protection (32 73 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.

1.3 WORK INCLUDED

A. The Contractor is responsible for installing and maintaining Orange Tree Save Barrier, as indicated on the plans or as directed by CUMMING UTILITIES.

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.

PART 2 - PRODUCTS

2.1 TREE SAVE BARRIER

A. Must have the following characteristics:

1. High visibility
2. Lightweight and easy to handle
3. UV stabilized fabric

4. 48” height
5. 100' prefabricated rolls or 300’ fabric rolls
6. 60” heavy duty oak stakes

PART 3 - EXECUTION

3.1 TEMPORARY FENCING

A. The Contractor shall install Tree Save Barrier as indicated on the Drawings, or as directed by CUMMING UTILITIES, to exclude the entry of equipment into designated save areas. Tree Save Barrier is to be installed at the beginning of construction before clearing and grubbing activities commence. Contractor shall be responsible for maintaining fence for its intended purpose until directed to remove fence by CUMMING UTILITIES. No work shall be allowed on private property and/or within CUMMING UTILITIES granted easements until Tree Save Barrier has been installed by the Contractor and inspected/confirmed by the Engineer and CUMMING UTILITIES. Where necessary, the Contractor shall obtain the services of a land surveyor, registered in the State of Georgia, to stake easement lines, right-of-way lines, and property lines to designate the limits of construction.

END OF SECTION 31 13 11

SECTION 31 20 00

EARTH MOVING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade pavements turf and grasses and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete pavements.
6. Subbase course and base course for asphalt paving.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at **Project site**.

1.4 INFORMATIONAL SUBMITTALS

A. Material test reports.

1.5 FIELD CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

B. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

PART 2 – PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification **Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487**, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: Per Geotech Engineer.
2. Plasticity Index: Per Geotech Engineer

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

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 created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements per Landscaping plan

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Landscaping plan.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 03 30 00 "Cast-in-Place Concrete."

E. Initial Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Shape subbase course and base course to required crown elevations and cross-slope grades.
2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.15 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 31 23 00

EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
1.3	Quality Assurance
1.4	Field Conditions
2.1	Bedding
2.2	Backfill
2.3	Top Soil
3.1	Initial Site Preparation
3.2	Protection of Trees and Shrubbery
3.3	Dewatering
3.4	Sheeting, Shoring, and Bracing
3.5	Excavation
3.6	Blasting
3.7	Unauthorized Excavations
3.8	Bedding
3.9	Backfilling
3.10	Fills and Embankments
3.11	Disposal of Waste and Unsuitable Materials
3.12	Final Grading
3.13	Top Soil
3.14	Settlement
3.15	Access by CUMMING UTILITIES'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 CUMMING UTILITIES. 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. Excavation material will be classified as earth and rock. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material NOT classified as rock excavation is classified as earth excavation. This work includes the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work.
7. It is understood and agreed that the Contractor has made a thorough investigation of the surface 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 one hundred and fifty feet (150'). 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 CUMMING UTILITIES. 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" through 3/4".

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 Section 31 11 00 – 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 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 CUMMING UTILITIES. 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 CUMMING UTILITIES.

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 CUMMING UTILITIES 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”) 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 CUMMING UTILITIES.

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 treatment 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 feet 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, CUMMING UTILITIES shall be notified immediately. CUMMING UTILITIES will promptly notify appropriate regulatory agencies, if necessary. In addition, CUMMING UTILITIES 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 CUMMING UTILITIES. Any other liquids will be disposed of properly, as directed by CUMMING UTILITIES and/or any regulatory agencies having jurisdiction. CUMMING UTILITIES 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 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 CUMMING UTILITIES 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, or basin. Provide adequate working space and clearances in excavations for the work to be performed therein.

2. Earth excavation includes excavating pavements and obstructions visible on the

surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

3. 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.

4. 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.

5. 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 CUMMING UTILITIES. 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 CUMMING UTILITIES. 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. Do not excavate rock until it has been classified and cross sectioned by Engineer.

2. Where necessary to excavate rock material in quantities of more than one cubic yard (1 CY) at a specific location, such material will be measured for payment as rock excavation included in pay item for trench rock excavation.

3. Include all cost of rock excavation (excavating, blasting, loading, hauling, crushing, backfilling, and/or disposing) in the unit price bid amount for the associated work.

4. In areas of trench rock excavation, provide the services of a Georgia licensed and registered land surveyor and survey crew to take measurements of ground elevations

and rock elevations before use of explosives for rock removal. The Contractor shall not backfill or otherwise cover adjacent exposed rock until completion of trench rock excavation measurements. Use survey elevations of the overburden or rock top surface along pipe centerline rock excavation area and compute rock removal quantities to the limits indicated in paragraph 3.5.C.6. Rock removed beyond specified lines and grades will not be measured for payment. Record rock drilling blast notes that measure the depth of the overburden to the top of rock surface to combine with the overburden top elevation measurements for rock volume computations. Furnish one (1) copy of survey notes, rock drilling blast notes, and rock volume computations to the City for review and approval for payment. Notify City 24 hours in advance of surveying.

5. 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.

6. 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

7. 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.

8. 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.

9. 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.

10. 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.

11. Conduct drilling and blasting operations in accordance with the requirements of paragraph 3.6, below.

12. 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 CUMMING UTILITIES's materials testing Engineer. 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") 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 CUMMING UTILITIES.

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 CUMMING UTILITIES.

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 feet (500') 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. Obtain written permission from authorities having jurisdiction before bringing explosives to Project Site or using explosives on Project Site.

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 CUMMING UTILITIES **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 inches (6") of rock below proposed grade line. All over-blast shall be removed and the resulting over-excavation 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 CUMMING UTILITIES'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 County 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, 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 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

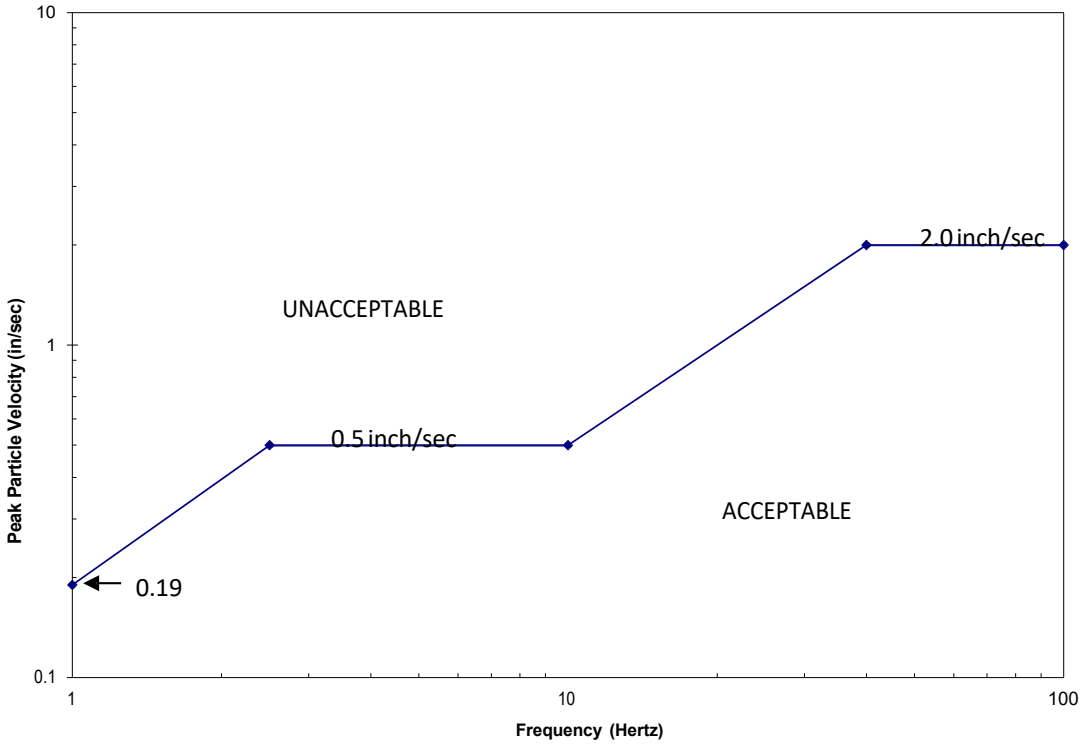
1. Exercise the utmost care not to damage property on-site and off-site. Notify each adjoining property owner within 500 feet of the site of the anticipated ground vibrations and noise which will occur due to the blasting operations. Provide this notice 30 days in advance to enable the adjacent property 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 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 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 CUMMING UTILITIES.

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 CUMMING UTILITIES.

D. Unless otherwise specified, at a minimum, Class 'D' 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, Class 'C' Bedding shall be used for gravity sanitary sewer of ductile iron pipe material.

F. Unless otherwise specified, at a minimum, Class 'B' Bedding shall be used for gravity sanitary sewer of polyvinylchloride (PVC) pipe material.

G. All pipe installed within rock excavation, shall be laid upon a minimum of six inches (6") 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') long and spaced every one hundred feet (100') 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 100% maximum dry density as determined by Modified Proctor, ASTM D-1557; or as directed by Engineer or CUMMING UTILITIES 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 around 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. For structures within paved areas (upper four feet) should be placed and compacted to 98%

of maximum dry density - Standard Proctor (ASTM D698), at a moisture content between 2 percent below and 3 percent above optimum moisture. 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% 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”) diameter will not be permitted in the trench bottom or in the Initial backfill, up to a depth of twelve inches (12”) 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") in thickness, and carefully and thoroughly consolidated by compacting simultaneously on both sides of the pipe to a height of twelve inches (12") above the pipe. Initial backfill material shall be free of rocks larger than two inches (2") 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'), 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") 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") and shall be compacted to a density of not less than 95% of maximum dry density, as determined by Standard Proctor (ASTM D698). The upper four feet (4') shall be compacted to a density of not less than 98% of maximum dry density, as determined by Standard Proctor (ASTM D698), at a moisture content between 2 percent below and 3 percent above the optimum moisture content. Final backfill in unpaved areas within road right-of-way shall be placed in lifts not to exceed eight inches (8") and shall be compacted to a density of not less than 90% of maximum dry density, as determined by Standard Proctor (ASTM D698). Final backfill in unpaved areas outside of road right-of-way shall be placed in lifts not to exceed eight inches (8") and shall be compacted to a density of not less than 85% 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") in diameter must be placed to the sides of the trench. Rocks larger than twelve inches (12") are not allowed.

6. Sub-base backfill is comprised of the top twelve inches (12") of Final backfill in paved areas and shall be free of rocks larger than four inches (4") in diameter, clods, organic matter, rubbish, or other unsuitable material. Sub-base backfill shall be placed in lifts not to exceed six inches (6"), and shall be compacted to 98% of maximum dry density, as determined by Standard Proctor (ASTM D698).

7. Backfilling shall not be performed in freezing weather (below 32° F) except by permission of CUMMING UTILITIES, 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 CUMMING UTILITIES, 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 CUMMING UTILITIES to make up for deficiency. Contractor must provide CUMMING UTILITIES 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’) 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 CUMMING UTILITIES, embankment shall be at least three feet (3’) deep over the top of the pipe, at least four feet (4’) wide at the top, with side slopes of not less than two horizontal 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, CUMMING UTILITIES, 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 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.

3.13 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.

3.14 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 CUMMING UTILITIES.

B. Make all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or CUMMING UTILITIES.

3.15 ACCESS BY CUMMING UTILITIES'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, Atterburg limits, compaction testing, permeability, etc.

B. All cost associated with initial material testing will be paid by CUMMING UTILITIES. 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 31 23 00

SECTION 31 11 00

DEWATERING

PART I – GENERAL

1.1 SECTION INCLUDES

A. This section specifies the control, handling, and disposal of groundwater and surface water during construction. This work includes the installation, operation, and removal of all facilities required to maintain open excavations and trenches in a dewatered condition to permit unrestricted construction operations.

B. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, trenches, foundations, materials, and structures during the course of the Work. The Contractor shall repair and replace all slopes, grades, foundations, materials, and structures damaged by water, both surface and subsurface, to the lines, grades, and conditions existing prior to the damage, at no additional cost to the Owner.

C. The Contractor shall construct all permanent work in areas free from water. The Contractor shall design, construct, and maintain all pumping systems, dikes, levees, cofferdams, and diversion and drainage channels as necessary to maintain construction areas free from water and to protect the areas occupied by permanent work from water damage. The Contractor shall remove temporary work after it has served its purpose.

D. Excavation/Trench Dewatering Requirements.

E. Stream and Surface Water Diversion Provisions.

F. Disposal of Water Removed from Excavations and Trenches.

1.2 RELATED SECTIONS

A. Section 312000 – Earth Moving

1.3 REFERENCES

A. Occupational Safety and Health Administration (OSHA) Regulations.

1.4 QUALITY ASSURANCE

A. The Contractor shall perform dewatering operations with supervisory personnel having at least 5 years' experience in field of dewatering.

B. The Contractor shall maintain adequate supervision and control to ensure that stability of excavated and constructed slopes are not adversely affected by water, that erosion is controlled and that flooding of excavation or damage to structures does not occur.

1.5 DEFINITIONS

A. **Dewatering**: includes lowering the water table and intercepting seepage which would otherwise emerge from slopes or bottoms of excavations and disposing of removed water. The intent of dewatering is to increase stability of excavated slopes; prevent dislocation of material from slopes or bottoms of excavations; reduce lateral loads on sheeting and bracing; improve excavating and hauling characteristics of excavated material; prevent failure or heaving of the bottom of excavations; and provide suitable conditions for placement of backfill materials and construction of structures and other installations.

B. **Surface drainage:** includes use of temporary drainage ditches and dikes and installation of temporary culverts and sump pumps with discharge lines as required to protect the Work from any source of surface water.

1.6 JOB CONDITIONS

A. Permits:

1. Prior to land disturbing activities or discharging water into a storm sewer or waterway, the Contractor shall obtain all necessary permits from the jurisdictional agencies and submit a Notice of Intent to the Georgia Environmental Protection Division by certified return receipt mail at least fourteen (14) days prior to conducting any land disturbance activities.
2. Notice of termination and applicable requirements to be submitted to the Georgia Environmental Protection Division and be approved prior to close out of project.

B. Responsibilities:

1. The Contractor shall select and install a system to control water as specified in this section, and to comply with the requirements of the jurisdictional agencies.
2. The Contractor shall take measures to prevent damage to properties, buildings or structures, sewers and other utility installations, pavements, sidewalks, and the Work.
3. The Contractor shall not overload or obstruct existing facilities.
4. The Contractor shall modify the dewatering system at no additional cost to the Owner if after installation and while in operation it causes or threatens to cause damage to existing buildings, structures, utilities, facilities, or other adjoining property.
5. The Contractor shall monitor the quality of the discharge from the dewatering system to determine if soil particles are being removed by the system and install

and maintain settling basins or other measures as required to control particle removal.

6. The Contractor shall measure and evaluate if movements are being caused to adjacent buildings, structures, utilities, facilities, or other adjoining properties by dewatering operations.
7. The Contractor shall repair damage, disruption, or interference resulting directly or indirectly from dewatering operations at no additional cost to the Owner and to the Owner Engineer's approval.
8. The Contractor shall submit plans and details for the protection of the Work where applicable. These plans shall include details of bulkheads, pumping facilities, dikes, and drainage.

1.7 PERFORMANCE REQUIREMENTS

A. The Contractor shall provide a dewatering system to produce the following results:

1. Effectively reduce the hydrostatic pressure affecting excavations.
2. Develop a substantially dry and stable subgrade for subsequent construction operations.
3. Preclude damage to adjacent properties, buildings, structures, utilities, installed facilities, and other work.
4. Prevent the loss of fines, seepage, boils, quick condition, or softening of the foundation strata.
5. Maintain stability of sides and bottom of excavations.

B. The Contractor shall provide drainage of seepage water, surface water, and water from any other source entering the excavation. Dewatering excavations and trenches may include placement of drainage materials, such as crushed stone and filter fabric, together with sump pumping.

C. The Contractor shall provide ditches, berms, pumps, and other methods necessary to divert and drain surface water from excavations and other Work areas.

D. The Contractor shall locate groundwater and surface water control and dewatering systems so as not to interfere with utilities, construction operations, adjacent properties, or adjacent water wells.

E. The Contractor shall assume sole responsibility for the dewatering system and for any loss or damage resulting from partial or complete failure of protective measures and any settlement, or resultant damage caused by the dewatering operations. The Contractor shall modify dewatering system if it causes or threatens to cause damage to new construction, existing improvements within the site of the Work, adjacent properties, or adjacent water wells. The Contractor shall repair damage caused by the dewatering system or damage resulting from failure of the dewatering system to protect properties as required.

1.8 SUBMITTALS

A. The Contractor shall submit a dewatering plan to the Owner prior to commencing Work. The dewatering plan shall be submitted for each site where required and include the following:

A description of the proposed dewatering system indicating arrangement, location, depth, and capacities of system components, installation details, and operation and maintenance procedures.

1. Design calculations (if any).
2. Standby equipment and power supply.
3. Location and size of berms, dikes, settling basins, sumps, and discharge items.
4. Pollution control facilities.
5. Discharge locations.
6. Surface water control and drainage installations.
7. Proposed methods and locations for disposing of removed water.
8. Copies of all permits and applications when submitted to permitting agency required to discharge water removed from construction areas.

B. Working drawings and supporting documents shall be revised and resubmitted to the Owner if the dewatering system is modified during installation or during operation.

PART 2 – PRODUCTS

(Not Used)

PART 3 - EXECUTION

3.1 PROTECTION OF RESOURCES

A. Construction operations shall be planned and conducted in such a manner so as to prevent adverse impact on streams, lakes, and reservoirs with sediment or other harmful material used in the construction of the project. The Contractor shall comply with all regulations of the Environmental Protection Agency (EPA), Georgia Environmental Protection Division, the Georgia Department of Transportation, and local issuing authority.

3.2 EXCAVATIONS/TRENCH DEWATERING

A. Dewatering shall include removal of all liquid, regardless of source, from excavations and trenches. The Contractor shall provide an adequate dewatering system for all excavations and trenches. The dewatering system shall be capable of removing any water that accumulates in excavations and trenches and maintain the excavation and trench in

a dry condition while construction is in progress. The area excavated at any time shall be limited to that which can be properly dewatered by the equipment or system in use.

B. The Contractor shall make the effort necessary to secure a dry trench bottom before bedding or haunching, laying pipe, placing concrete, or backfilling. If, in the opinion of the Owner, the Contractor has failed to obtain an absolutely dry trench bottom by insufficient use of all known methods of trench dewatering, the Owner may order the Contractor to excavate below grade and place not less than six (6) inches of graded crushed stone fill material over the trench bottom to form french drains to suitably locate sumps and to remove the water by bailing or pumping. The graded crushed stone fill material shall be placed at the Contractor's expense, and shall be of such depth that there shall be no water in bell holes at the time of coupling the pipe.

C. The Contractor shall provide and maintain ditches of adequate size to collect surface water and seepage which may enter the excavations and divert the water into a sump so that it can be drained or pumped into drainage channels and settling basins prior to discharge to storm sewers if approved by the Owner and the jurisdictional agency concerned.

D. The Contractor shall install all drainage ditches, sumps, and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables and to drain impervious surfaces at final excavation elevation.

E. The Contractor shall perform dewatering operations by means which will insure dry excavations, preserve final lines and grades, and not disturb or displace adjacent soil.

F. Excavations shall be continuously dewatered to maintain a ground water level no higher than two (2) feet below the lowest point in the excavation. Dewatering shall be accomplished well enough in advance of excavation to ensure that groundwater is already lowered prior to completing the final excavation to finish subgrade.

G. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least two (2) feet below the bottom of the trench. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump at least two (2) feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise stop operating.

H. The Contractor shall dewater trenches by use of a well point system when pumping from sumps does not lower the water level at least two (2) feet below the trench bottom. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. A casing, six (6) to ten (10) inches in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand, and withdrawing the casing.

I. All destabilized subgrade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at no additional cost to the Owner.

J. The Contractor shall install settling basins or other approved apparatus as required to control the amount of fine particles and other pollutants which may be carried by water diverted into storm sewers or flowing off the site of the Work.

K. Should a storm sewer become blocked or have its capacity restricted due to the dewatering operations, the Contractor shall make arrangements with the jurisdictional agency for the cleaning of the sewer and appurtenances at no additional cost to the Owner.

L. The Contractor shall backfill drainage ditches, sumps, and settling basins when no longer required, with granular material, concrete, or other material as approved by the Owner.

3.3 STREAM AND SURFACE WATER DIVERSION

A. The Contractor shall use all practical means such as ditches, berms, dikes, sand bags, hay bales, or other methods, approved by the Owner's Engineer, to prevent surface water from entering excavations. The diversion of surface water shall be performed in a manner that will prevent the accumulation of water around structures or any other locations within the site of the Work where it may be detrimental.

1. The Contractor shall intercept and divert surface drainage away from the excavations, by the use of dikes, curb walls, ditches, pipes, sumps, or other means.
2. The Contractor shall design surface drainage systems so that they do not cause erosion on or off the site or cause unwanted flow of water.
3. The Contractor shall remove the surface drainage system when no longer required.
4. The Contractor shall remove debris and restore the site or sites to original condition.
5. Where pipes cross natural drainage channels, the Work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the Work shall be prevented.

B. If stream diversion or relocation around the site of the Work is required, the Contractor shall return the stream to its original location and contours. Slopes in stream relocations shall be seeded above the waterline.

3.4 DISPOSAL OF WATER REMOVED FROM EXCAVATIONS AND TRENCHES

A. The Contractor shall dispose of water from the Work in accordance with the regulations established by the Environmental Protection Agency (EPA), Georgia Environmental Protection Division and in a manner approved by the Owner.

B. The Contractor shall dispose of the water resulting from dewatering operations in a manner that will not damage or interfere with the normal drainage of the site of the Work. In addition, the Contractor shall protect from damage any portion of the Work completed or in progress, surfaces of streets, and public or private property.

C. All gutters, drains, culverts, storm sewers, and inlets around the site of the Work shall be kept clean and open for normal surface drainage.

D. The Contractor shall not direct water across or over pavement except by methods approved by the Owner. Water shall not be drained into Work under construction.

E. Water removed from excavations and discharged into streams shall be filtered through granular material prior to pumping or through hay bales and siltation fabric after pumping, or both, if required by the Owner. Discharges into streams shall be conducted in accordance with regulations established by the Environmental Protection Agency (EPA) Georgia Environmental Protection Division

3.5 OBSERVATION WELLS

A. The Contractor shall provide, take measurements and maintain at least a minimum number of observation wells (piezometers) as indicated and additional observation wells as may be required by governing authorities.

B. The Contractor shall observe and record daily elevation of groundwater and piezometric water levels in observation wells.

C. The Contractor shall repair or replace within 24 hours, observation wells that become inactive, damaged, or destroyed. If required, suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. The Contractor shall add or remove water from observation well risers to demonstrate that observation wells are functioning properly.

D. The Contractor shall remove observation wells when dewatering completed.

END OF SECTION 31 23 19

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Definitions
1.4	Work Included
1.5	Submittals
1.6	Regulatory Compliance
2.1	Check Dam – Stone (Cd-S)
2.2	Construction Exits (Co)
2.3	Temporary Interceptor, Diversion, and Perimeter Dikes (Di)
2.4	Temporary Interceptor, Diversion, and Perimeter Ditches (Di)
2.5	Sediment Barrier - Temporary Silt Fence (Sd1-NS, Sd1-S)
2.6	Sediment Barrier – Hay Bales (Sd1)
2.7	Inlet Sediment Trap (Sd2)
2.8	Storm Drain Outlet Protection – Riprap (St)
2.9	Surface Roughening (Su)
2.10	Buffer Zone (Bf)
2.11	Disturbed Area Stabilization - Mulching Only (Ds1)
2.12	Disturbed Area Stabilization – Temporary Seeding (Ds2)
2.13	Disturbed Area Stabilization – Permanent Vegetation (Ds3)
2.14	Disturbed Area Stabilization – Sodding (Ds4)
2.15	Dust Control (Du)
2.16	Permanent Slope Stabilization (Ss)
2.17	Anionic Polyacrylamide – PAM (Pm)
3.1	Check Dam – Stone (Cd-S)
3.2	Construction Exits (Co)
3.3	Temporary Interceptor, Diversion, and Perimeter Dikes (Di)
3.4	Temporary Interceptor, Diversion, and Perimeter Ditches (Di)
3.5	Sediment Barrier - Temporary Silt Fence (Sd1-NS, Sd1-S)
3.6	Sediment Barrier – Hay Bales (Sd1)
3.7	Inlet Sediment Trap (Sd2)
3.8	Storm Drain Outlet Protection – Riprap (St)
3.9	Surface Roughening (Su)
3.10	Buffer Zone (Bf)
3.11	Disturbed Area Stabilization - Mulching Only (Ds1)
3.12	Disturbed Area Stabilization – Temporary Seeding (Ds2)
3.13	Disturbed Area Stabilization – Permanent Vegetation (Ds3)

3.14 Disturbed Area Stabilization – Sodding (Ds4)
3.15 Dust Control (Du)
3.16 Permanent Slope Stabilization (Ss)
3.17 Anionic Polyacrylamide – PAM (Pm)
3.18 Notice of Intent (NOI)
3.19 Inspections and Maintenance
3.20 Monitoring and Reporting
3.21 Notice of Termination (NOT)
3.22 Removal of Temporary Sediment Control Structures
3.23 Sequence of Construction of Temporary Sediment Control Measures
3.24 Specific Requirements
3.25 Permitting

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Exploratory Excavation (02 32 19).
2. Clearing and Grubbing (31 11 00).
3. Excavation and Fill (31 23 00).
5. Turf and Grasses (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. GAR100002 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 edition.

2. 2016 Manual for Erosion and Sediment Control in Georgia (the "Green Book").

3. State of Georgia Department of Transportation Standard Specifications, Construction of Transportation Systems, (GDOT specifications), latest edition.

4. National Stone Association, Aggregate Classification (NSA Classification).

5. Forsyth County, or local issuing authority Soil Erosion and Sediment Control Ordinance, latest edition.

6. 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.

7. 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 GAR 100002, Part I.B. 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

"NPDES General Permit No. GAR100002 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, latest edition, under this item.

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 and recording 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 CUMMING UTILITIES.

C. The Designer, Engineer, or CUMMING UTILITIES, 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 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 following documents and the documents referenced therein define the regulatory requirements for this item:

1. NPDES GENERAL PERMIT: NPDES General Permit No. GAR100002, 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, latest edition. Governs land disturbance construction activities of one (1.0) acre or more. On applicable sites, Contractor is responsible for complying with terms and conditions of this Permit.
2. MANUAL FOR EROSION AND SEDIMENT CONTROL: Contractor shall follow Practices and Standards of the Georgia Soil and Water Conservation Commission ***2016 Manual for Erosion and Sediment Control in Georgia***, latest edition.
3. SWP3: When a Stormwater Pollution Prevention Plan (SWP3) is provided in the Contract Documents, the Contractor shall follow the practices described in the SWP3.

PART 2 - PRODUCTS

2.1 CHECK DAM – STONE (Cd)

A. Geotextile plastic filter fabric underliner shall meet the requirements of the Georgia Department of Transportation, Standard Specifications, Construction of Transportation Systems, Section 881, latest edition.

2.2 CONSTRUCTION EXITS (Co)

A. Geotextile underliner shall conform to AASHTO M288-96, Section 7.3, and shall be used in all instances to separate soil base and graded stone aggregate. Stone aggregate size shall conform to the National Stone Association's (NSA) R-2 Classification (1½" to 3½") stone.

2.3 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DIKES (Di)

A. A ridge of compacted soil, constructed above, across, or below a slope.

2.4 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DITCHES (Di)

A. A channel depression in soil, above, across, or below a slope.

2.5 SEDIMENT BARRIER - TEMPORARY SILT FENCE (Sd1-NS, Sd1-S)

A. Non-Sensitive Areas (Type 'NS'): Filter fabric shall be thirty-six inch (36") wide, woven fabric slit tape yarns allowed in one direction only, and must meet the requirements set forth in Section 171- Temporary Silt Fence, of the GDOT Standard Specifications,

Construction of Transportation Systems, latest edition. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric complies with these specifications. Posts shall be a minimum of four feet (4') long and made of either wood or steel. Wood posts shall be 1½" x 1½" hardwood and made from Ash, Hickory, or Oak. Fabric shall be fastened to wood posts with at least 5 wire staples per post. Staples shall be 17 gauge minimum and shall have a crown at least ¾ inch wide and legs at least ½ inch long. Steel posts shall be "U", "T", or "C" shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the filter fabric to the posts.

B. Sensitive Areas (Type 'S'): Filter fabric shall be thirty-six inch (36") wide, non-calendered woven fabric constructed with monofilament yarns only, and must meet the requirements set forth in Section 171- Temporary Silt Fence, of the GDOT Standard Specifications, Construction of Transportation Systems. Contractor shall submit to Engineer copies of delivery invoices, certifications, or other documentation that the filter fabric complies with these specifications. Wire fence fabric shall be at least thirty-two inch (32") high and shall have at least six (6) horizontal wires. Vertical wires shall have a maximum spacing of twelve inches (12"). Top and bottom wires shall be at least 10 gauge and all other wires shall be at least 12½ gauge. Posts shall be steel and have a minimum length of five feet (5'). Steel posts shall be "U", "T", or "C" shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the woven wire and filter fabric to the posts.

2.6 SEDIMENT BARRIER - HAY BALES (Sd1)

A. Hay bales may be made of hay or wheat straw and shall be wire or nylon bound and of rectangular shape.

2.7 INLET SEDIMENT TRAP (Sd2)

A. Filter fabric used on constructing inlet sediment traps shall conform to the requirements listed above in paragraph 2.5.A. SEDIMENT BARRIER - TEMPORARY SILT FENCE (Sd1-A). For gravel drop inlet filters, stone shall conform to NSA's R-3 Specification (3 to 6 inch stone). Baffle Box Inlet Filters shall be constructed of 2 inch x 4 inch posts and 2 inch x 4 inch boards.

2.8 STORM DRAIN OUTLET PROTECTION - RIPRAP (St)

A. Unless otherwise specified, stone furnished for riprap shall meet the requirements of the Georgia Department of Transportation, Standard Specifications, Construction of Transportation Systems, Sections 603 and 805, latest edition.

B. Rock from onsite excavation may be used as stone riprap, provided it meets all of the following requirements:

1. The rock meets GDOT specifications as noted above in paragraph 2.8.A.,

2. CUMMING UTILITIES construction material testing representative certifies the rock as suitable for the use intended,

3. CUMMING UTILITIES approves the use of onsite materials.

B. Plastic filter fabric underliner shall meet the requirements of the Georgia Department of Transportation, Standard Specifications, Construction of Transportation Systems, Section 881, latest edition.

2.9 SURFACE ROUGHENING (Su)

A. Soil slope steeper than 3:1.

2.10 BUFFER ZONE (Bf)

A. A strip of undisturbed, original vegetated area bordering streams, ponds, wetlands, and lakes.

2.11 DISTURBED AREA STABILIZATION – MULCHING ONLY (Ds1)

A. Dry straw shall be applied to a depth of 2 to 4 inches, at a rate of two tons per acre (2T/Ac.).

B. Dry hay shall be applied to a depth of 2 to 4 inches, at a rate of two and one-half tons per acre (2½ T/Ac.).

C. Wood waste (chips, sawdust, or bark) shall be applied to a depth of 2 to 3 inches.

2.12 DISTURBED AREA STABILIZATION – TEMPORARY SEEDING (Ds2)

A. Seed shall be clean, delivered in original, unopened packages and bearing an analysis of contents. Guaranteed 95 percent pure with minimum germination rate of 85 percent. Summer seed mix shall be 40 percent by weight Fawn Fescue, 30 percent by weight Perennial Ryegrass, 15 percent by weight Orchard Grass, and 15 percent by weight Dutch White Clover. Winter seed mix shall be 35 percent by weight Fawn Fescue, 30 percent by weight Perennial Ryegrass, 30 percent by weight Hairy Vetch, and 5 percent by weight Dutch White Clover. Alternative mixes may be approved by the Engineer. Fertilizer shall be used as specified, and/or indicated on the Drawings. Fertilizer shall be commercial, chemical type, uniform in composition, free-flowing, conforming to state and federal laws, and suitable for application with equipment designed for that purpose. Fertilizer shall have a minimum percentage of plant food by weight for the following: Summer mix shall be 10 percent nitrogen, 10 percent phosphoric acid, and 6 percent potash. Straw mulch shall be threshed straw of oats, wheat, or rye free from obnoxious weeds and seeds, or shall be clean hay. Average stalk length shall be 6 inches. Wood waste or erosion control matting, such as jute or excelsior, is appropriate alternatives to hay or straw mulch for temporary stabilization.

2.13 DISTURBED AREA STABILIZATION – PERMANENT VEGETATION (Ds3)

A. Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seeds shall be furnished in original, unopened, sealed standard containers. The minimum percentage by weight of pure live

seed in each lot of seed shall be as follows:

1.

Seed Type	Percent
K31 Fescue	95
Material other than grass seed	5
Total	100

B. The aggregate percent of material other than grass seed shall include all non-viable seed, chaff, bulbs, live seed of crop plants other than those specified above, harmless inert matter, and weed seed not exceeding 1.0% by weight of pure live seed and other material in the mixture.

C. Commercial fertilizer shall be composed of a formula of 20-12-10 and shall conform to applicable Georgia fertilizer laws. It shall be uniform in composition, dry, and free flowing and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer, which becomes caked or otherwise damaged making it unsuitable for use, shall not be accepted.

D. Agricultural limestone shall be an acceptable grade of ground limestone, ground dolomite, or a mixture of limestone and dolomite meeting the following physical and chemical requirements:

1. Gradation

Standard Sieve Size	Maximum Percent (%) Retained
No. 8, maximum	10
No. 100, maximum	75

E. The vegetative mulch shall be the cereal straw from stalks of oats, rye, wheat, or barley. The straw shall be free of prohibited weed seeds and shall be relatively free of all other noxious and undesirable seeds. The straw shall be clean and bright, relatively free of foreign material and be dry enough to spread properly.

F. Topsoil: ASTM D 5268, pH range of 5.5 to 7.4 percent organic material minimum, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
2. The Contractor shall furnish topsoil free from objectionable materials such as hard clods, stiff clay, sods, hardpan, partially disintegrated stone, plant stumps, large roots, litter, or other materials that are not integrally a natural component of good agricultural soils and which are harmful to or unnecessary for successful plant growth.

2.14 DISTURBED AREA STABILIZATION – SODDING (Ds4)

A. Turfgrass Sod: Complying with “Specifications for Turfgrass Sod Materials” in TPI's “Guideline Specifications to Turfgrass Sodding.” Furnish viable sod of uniform

density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Bermudagrass, Carpetgrass, Axonopus, Centipedegrass, St. Augustinegrass, and Zoysiagrass.

C. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full sun: Kentucky bluegrass, a minimum of three cultivars.

2. Sun and partial shade: Proportioned by weight as follows:
   a. 50 percent Kentucky bluegrass.
   b. 30 percent Chewings Red Fescue.
   c. 10 percent Perennial Ryegrass.
   d. 10 percent Redtop.

3. Shade: Proportioned by weight as follows:
   a. 50 percent Chewings Red Fescue.
   b. 35 percent Rough Bluegrass.
   c. 15 percent Redtop.

D. Topsoil: ASTM D 5268, pH range of 5.5 to 7.4 percent organic material minimum, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

2. The Contractor shall furnish topsoil free from objectionable materials such as hard clods, stiff clay, sods, hardpan, partially disintegrated stone, plant stumps, large roots, litter, or other materials that are not integrally a natural component of good agricultural soils and which are harmful to or unnecessary for successful plant growth.

2.15 DUST CONTROL (Du)

A. Dry straw shall be applied to a depth of 2 to 4 inches, at a rate of two tons per acre (2T/Ac.).

B. Irrigation provided by use of a water truck to wet down the disturbed area.

C. Asphalt emulsion shall be SS-1, SS-1h, CSS-1 or CSS-1h conforming to the requirements of AASHTO M140-70 or AASHTO M208-72.

2.16 PERMANENT SLOPE STABILIZATION (Ss)

A. All matting and blanket materials shall be Tensar TriAx Geogrid.

2.17 ANIONIC POLYACRYLAMIDE (Pm)

A. Anionic Polyacrylamide shall be non-toxic and can be water-soluble chemical or log form. All Anionic Polyacrylamide products, whether in Powder, Liquid/Emulsion, or log form, shall meet the USEPA Grade 2 classification, "Generally Regarded as Safe (GRAS)". The Contractor shall submit Safety Data Sheets (SDS) to Engineer for approval of Anionic Polyacrylamide. Handling and application of the product shall adhere to the SDS requirements and recommendations.

B. Liquid/Emulsion form of Anionic Polyacrylamide shall be Applied Polymer Systems, Series 600, or approved equal. Powder form of Anionic Polyacrylamide shall be Applied Polymer Systems, Series 700, or approved equal. Specific polymer type used shall be as per manufacturer's recommendation for Forsyth County soil classifications.

PART 3 - EXECUTION

3.1 CHECK DAM – STONE (Cd-S)

A. Install stone check dams as specified, indicated on the Drawings, or as directed by Designer, Engineer, or CUMMING UTILITIES.

B. Installation: Install check dams in all ditches, channels, or swales draining disturbed areas of up to two (2) acres, and which are not installed with permanent, non-erodible lining or a vegetative cover as specified in paragraphs 2.13 and 2.14 of these specifications.. The specifications for the design criteria, material, 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 (2) acres.

1. Construct check dam with graded size 5 to 10 inch stone. Hand placement may be required to ensure complete coverage of the entire width of ditch.
2. The center of the check dam must be at least nine inches (9") lower than the edges. Dam height shall be a maximum of two feet (2'), as measured at center of check dam.
3. Side slopes shall be 2:1 or flatter.
4. Two (2) or more check dams placed in series shall be used for drainage areas greater than one (1) acre. Maximum spacing between dams shall be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
5. A geotextile underliner meeting the requirements of paragraph 2.1.A. shall be used as a separator between the graded stone and the soil base.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all check dams shall be inspected and maintenance performed, if needed, within 24 hours of inspection. Inspection shall occur at least once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Dress dams with appropriate sized stone, as necessary, to maintain check dams in accordance with these specifications. At the earlier of: 1): Every fourteen (14) calendar days, or 2): when sediment reaches a depth of one-half (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.

3.2 CONSTRUCTION EXITS (Co)

A. Install construction exits as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES.

B. Installation: Construction exits shall be installed at all points where traffic shall be leaving the construction site onto 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 other land disturbance construction operations.

1. The stone pad thickness shall be a minimum of six (6) inches.
2. The stone pad width shall equal the full width of all points of vehicular egress, but not less than twenty (20) feet wide.
3. If the stone pad does not sufficiently remove the mud from tires prior to entering onto public right-of-way, washing is required. Washing shall be performed on a stabilized area, and the sediment-laden runoff shall be directed into an approved sediment trap.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all construction exits shall be inspected and maintenance performed, if needed, within 24 hours of inspection, once every seven (7) calendar days and within 24 hours of rainfall an event that has precipitation of ½ inch or greater. At the earlier of: 1) fourteen (14) calendar days since construction exit was installed or last maintained, or 2) geotextile underliner is visible, or 3) 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 underliner is no longer visible and exit pad conforms to specifications.

3.3 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DIKES (Di)

A. Install temporary interceptor, diversion, and perimeter dikes as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES, to intercept and prevent stormwater runoff from entering disturbed areas from any other upgrade area regardless of whether area is onsite or offsite. Dikes must divert runoff to a drainage ditch, sediment basin, temporary or permanent channel. Dikes shall remain in place until the disturbed area is permanently stabilized. Construct dikes of earth fill free from all perishable matter and refuse, such as scrap forms, wire, brush, rocks larger than six (6) inches or any foreign materials. Ashes, large stones, muck, or other soft materials shall not be used. Compact all dikes using construction equipment. Dikes shall be stabilized immediately after construction with temporary seeding to prevent sediment transport to downstream areas.

3.4 TEMPORARY INTERCEPTOR, DIVERSION, AND PERIMETER DITCHES (Di)

A. Install temporary interceptor, diversion, and perimeter ditches as specified, indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES. In general, temporary ditches shall be installed parallel and contiguous to, and upgrade

of temporary dikes. Construct ditches to the lines and cross section indicated on the Drawings, provided that ditches have a minimum depth of one foot and side slopes have a slope of 2H:1V or flatter. Ditches shall be free of bank projections, trees, brush, stumps, or other objectionable materials or irregularities that shall impede normal flows. Downstream outlets of temporary ditches shall be constructed and stabilized prior to construction of the ditch. The outlet must discharge in such a manner as to not cause an erosion problem.

3.5 TEMPORARY SEDIMENT BARRIERS - SILT FENCE (Sd1-NS, Sd1-S)

A. Install silt fence as specified, as indicated on the Drawings or as directed by the Designer, Engineer, or CUMMING UTILITIES.

B. Installation: In general, silt fencing shall be installed on the downgrade side of all areas to be disturbed as well as the perimeter of the project site. All posts used to install silt fence shall comply with the specifications of paragraph 2.5. Posts must be placed at least 18 inches in the ground and spacing cannot be more than four (4) feet center-to-center for Type 'C' fencing, and six (6) feet center-to-center for Type 'A' fencing. Fence fabric must be inserted below ground in a six (6) inch trench, and fence fabric must be fastened to posts according to the specifications of paragraph 2.5. Contractor shall install Type 'A' or Type 'C' silt fence, as specified, as indicated on the Drawings, or when directed by the Designer, Engineer, or CUMMING UTILITIES.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all silt fencing shall be inspected and maintenance performed, if needed, within 24 hours of inspection and once every seven (7) calendar days, and within 24 hours of a rainfall event that had precipitation of ½ inch or greater. All silt fencing materials, including fabric, post and fasteners must be replaced six (6) months after installation. At the earlier of: 1) every fourteen (14) calendar days, or 2) when sediment reaches a depth of one half the installed fence height; all soil, silt, sediment and other material captured by the silt fence should be removed and returned upgrade on the construction site. The silt fence shall be maintained such that it minimizes sediment transport as designed.

3.6 SEDIMENT BARRIER - HAY BALES (Sd1)

A. Install hay or straw bales as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES.

B. Installation: Place bales in a row with ends tightly abutting the adjacent bales. Corner abutment is not acceptable. Embed bales in the soil a minimum of 4 inches below grade. Build up backfilled soil a minimum of 4 inches above grade on the uphill side of the barrier and conform to grade on the downhill side of the barrier. Anchor each bale in place with 2" by 2" inch wood stakes or No. 3 reinforcing bars. The first stakes shall be driven toward the previously laid bale to force the bales together. Stakes shall be thirty six (36) inches long and shall be driven a minimum of eighteen (18) inches into the ground.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all hay bales shall be inspected and maintenance performed, if needed, within 24 hours of inspection once every seven (7) calendar days, and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Hay bales must be replaced thirty (30) calendar days after installation. At the earlier of: 1) every fourteen (14) calendar days,

or 2) when sediment and other material captured by the hay bales reaches ½ the height of the original bales, such sediment should be removed and returned upgrade on the construction site. The hay bales shall be maintained such that they minimize sediment transport as designed.

3.7 INLET SEDIMENT TRAP (Sd2)

A. Install inlet sediment traps as specified, as indicated on the Drawings, or as directed by the Designer, Engineer or CUMMING UTILITIES.

B. Installation: Install in accordance with Chapter Six (6) of the 2016 Manual for Erosion and Sediment Control in Georgia. Excavation may only be used in combination with a filtering device such as stone or silt fence. All sediment traps should provide a minimum of 1.5 feet of sediment storage. Sediment traps must be self-draining.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all inlet sediment traps shall be inspected and maintenance performed, if needed, within 24 hours of inspection, once every seven (7) calendar days, and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Clean and repair traps such that traps meet the specifications of this section and minimize sediment transport. At the earlier of: 1): Every fourteen (14) calendar days, or 2): when sediment reaches a depth of one-half (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.

3.8 STORM DRAIN OUTLET PROTECTION – RIPRAP (St)

A. Install storm drain outlet protection as specified, as indicated on the Drawings, or as directed by the Designer, Engineer or CUMMING UTILITIES.

B. Installation: Prepare the ground surface where riprap will be placed to conform with lines and grades as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES. Ground surface shall be smooth and free from obstructions, depressions, or debris. Place woven plastic filter fabric underliner on the prepared ground surface under all riprap. Place riprap to a uniform thickness as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES. If no thickness is specified, place riprap to a minimum thickness of eighteen (18) inches.

C. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all storm drain outlets shall be inspected and maintenance performed, if needed, within 24 hours of inspection, once every seven (7) calendar days, and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Repair storm drain outlet protection such that riprap meets the specifications of this section and minimizes sediment transport.

3.9 SURFACE ROUGHENING (Su)

A. Perform surface roughening as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES.

B. Roughening is best used on cut and fill slopes steeper than 3H:1V, which will not be

mowed. In those areas use the method of *grooving,* this consists of using machinery to create a series of ridges and depressions, and shall run perpendicular to the slope.

C. Using a bulldozer tread for *tracking* as a method of roughening is discouraged, unless no alternatives are available. This causes undue compaction of surface soils and is counter –productive to establishing vegetative growth. When using *tracking* as a technique, use as few passes of the machinery as possible to minimize compaction of the ground surface.

D. Roughened areas shall be vegetated (mulch, seed, sod, etc.) as specified, indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES, as soon as possible to obtain optimum growth.

3.10 BUFFER ZONE (Bf)

A. Construction within a buffer zone of a body of water designated as Waters of the United States must meet the requirements listed below in this specification paragraph.

B. Definition: The buffer zone is officially defined as the distance, in feet, from the edge of the normal high water line (or for wetlands, the distance from the boundary of the wetland). For the purpose of Work in Forsyth County, the buffer zone for small streams (as determined by the Engineer) shall start at the top of the bank and the buffer zone for larger streams (as determined by the Engineer) and rivers shall start at the edge of the vegetation. Buffer zones are specified in the table below.

C.

Type of Waters of the United States	Buffer
Chattahoochee River	100 feet
Tributaries Within 2000 Feet of Chattahoochee River	35
feet Big Haynes Creek	50 feet
Other Waters of the United States	25 feet

D. Construction Activity: Construction activity within the buffer zone must be approved by a variance granted by Georgia EPD. Any encroachments must immediately be mulched and/or seeded in accordance with the requirements of paragraph 2.12. titled Disturbed Area Stabilization – Temporary Seeding. All construction within a buffer zone must be complete as soon as possible, and within 24 hours when possible of initial land disturbance within the buffer.

3.11 DISTURBED AREA STABILIZATION – MULCHING ONLY (Ds1)

A. When mulch only is used without subsequent seeding, mulch shall be applied to provide full coverage of the exposed area. Dry straw or hay, and wood chips shall be applied uniformly by hand or mechanical equipment designed for that specific use.

B. For areas to receive mulch only, apply at the following rates, to the following depths, and according to the following specifications:

1. Dry Straw or Hay: Spread at a rate of two and one half (2 ½) tons per acre. Apply to a depth of 6 to 10 inches. Apply uniformly and anchor as necessary.

2. Wood Waste: Spread at a rate of 6 to 9 tons per acre. Apply to a depth of 2 to 3

inches. Apply wood waste only on slopes that are 3:1 or flatter. Anchoring is not necessary.

3. Jute Matting or Excelsior Netting: Apply in accordance with manufacturer's recommendations.

4. Asphaltic Emulsion: Apply at a rate of 1200 gallons per acre. Apply uniformly.

C. If the area will eventually be covered with perennial vegetation, 20-30 pounds per acre of nitrogen, in addition to the normal amount of nitrogen, shall be applied to the area to offset the uptake of nitrogen caused by the decomposition of organic mulches.

3.12 DISTURBED AREA STABILIZATION – TEMPORARY SEEDING (Ds2)

A. This section covers Work necessary for temporary stabilization of soil to prevent erosion following clearing, grubbing, grading or other construction, except wetlands. Temporary stabilization within a buffer zone of Waters of the United States shall meet the requirements of paragraph 3.10 titled Buffer Zone.

B. General Criteria: The stabilization measures specified herein shall be initiated on all disturbed areas including dikes and ditches within 24 hours of completion to minimize erosion and soil transport. However, stabilization measures specified herein do not have to be initiated in the event that construction activities shall resume on that portion of the site within fourteen (14) days from the date activities temporarily ceased. For cleared areas which may not receive permanent vegetative or other stabilization measures for six (6) months or less, and a suitable growing season is not available for seeding to establish an erosion retardant cover, mulch may be applied according to the specifications below:

1. Contractor shall submit to Engineer, certificates of inspection of seed by state or federal authorities and copies of delivery invoices or other documentation of quantities of mulch and fertilizer.

2. Contractor shall give at least a three (3) day notice to CUMMING UTILITIES for the time and place of the grass planting.

3. Contractor shall keep Engineer and CUMMING UTILITIES advised of schedule of operations.

C. Application: Planting and seeding shall be performed in accordance with the following schedule:

1. Summer Seeding: No earlier than April 1 and no later than October 15.

2. Winter Seeding: October 16 until weather conditions prohibit further construction operations as determined by the Engineer.

3. Soil Preparation: Prior to seeding operations, and after surface has been shaped, graded, and compacted, scarify surface to a minimum depth of 1 inch.

4. Seeding: All seedbeds shall be a minimum depth of 1 inch. Seedbeds shall be reviewed by CUMMING UTILITIES, prior to seeding. After soil has been scarified, apply required seed mix, as specified in this section, uniformly with a cyclone seeder, drill, culti-packer seeder, or hydro-seeder. When hydro-seeding is the selected method of seeding, prepare and apply slurry at the rate and proportion

specified below:

Seed Mix 100 lbs/acre
Fertilizer 650 lbs/acre
Water as necessary

5. The required fertilizer mix shall be uniformly applied at the time of seeding. Fertilizer shall not be applied to a land area within a buffer zone area of a body of water in a Waters of the United States.

6. Upon completion of the seeding operations, apply straw mulch to a uniform thickness of 1 ½ inches to 2 ½ inches in depth. Mulch shall be loose enough to permit penetration of sunlight and air circulation, but dense enough to shade ground, reduce evaporation rate, and prevent or materially reduce erosion of underlying soil. Retain straw in place by applying asphaltic emulsion at a rate of 100 gallons per acre or mechanically tack the mulch into the soil to approximately 3 inches. Equipment used for tacking shall be specially designed for this use.

D. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all stabilized areas shall be inspected and maintenance performed, if needed, within 24 hours of inspection, once every seven (7) calendar days and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Apply additional stabilization materials as needed.

3.13 DISTURBED AREA STABILIZATION – PERMANENT VEGETATION (Ds3)

A. The subgrade for areas to be seeded shall be brought to a uniform grade, free of large stones. Topsoil shall be uniformly graded, trimmed, and raked free from unsuitable material, ridges, bumps, or depressions. Over this area, spread agricultural lime at the rate of 50 pounds per 1000 square feet, and spread fertilizer uniformly on the surface of the ground at the rate of 35 pounds per 1000 square feet. Mix the lime and fertilizer uniformly into the top four (4) inches of the soil by suitable harrows, rotary tillers, or other approved equipment.

B. Seeding shall be performed using a properly proportioned mixture of inoculated seed approved for use in The Piedmont Region “Zone One” as detailed in the 2016 Manual for Erosion and Sediment Control in Georgia. Seeding shall only be permitted during the planting season listed for The Piedmont Region. All seeded areas shall be uniformly mulched immediately after seeding.

C. The Contractor shall be responsible for maintaining all planted areas including, watering, and reseeding defective area until a stand of grass covering ninety percent (90%) of the entire stabilized area is established, and Final Acceptance of the Work by the Engineer is obtained. Areas showing evidence of settlement or loss of topsoil shall be rebuilt and reseeded as required.

3.14 DISTURBED AREA STABILIZATION – SODDING (Ds4)

A. The subgrade for the areas to be sodded shall be brought to a uniform grade, free of large stones. Topsoil shall be uniformly graded, trimmed, and raked free from

unsuitable material, ridges, bumps, or depressions. Over this area, spread agricultural lime at the rate of 50 pounds per 1000 square feet, and spread fertilizer uniformly on the surface of the ground at the rate of 35 pounds per 1000 square feet. Mix the lime and fertilizer uniformly into the top four (4) inches of the soil by suitable harrows, rotary tillers, or other approved equipment.

B. Sod shall be carefully placed and rolled to insure good soil contact.

3.15 DUST CONTROL (Du)

A. The stabilization measures contained in this section are for controlling surface and air movement of dust on construction sites.

B. Temporary Methods: Dust may be controlled by use of mulches, tillage, and irrigation. For mulches, refer to paragraphs 2.11 and 3.11 Disturbed Area Stabilization – Mulching Only. For emergency measures to deploy before wind erosion starts, tillage and irrigation may be implemented. The practice of tillage is designed to roughen and bring clods to the surface. Irrigation to be accomplished by sprinkling water on the surface until the surface is wet and no longer produces dust. This must be repeated as necessary to minimize dust production.

C. Permanent Methods: Applying topsoil (a less erosive soil material), crushed stone, and sodding to disturbed areas may be used to permanently control dust.

3.16 PERMANENT SLOPE STABILIZATION (Ss)

A. Matting and blankets shall be installed as specified, as indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES.

B. Matting and blankets can be applied in areas of concentrated flows, on slopes steeper than 2½H:1V with a height of ten (10) feet or greater, and cuts and fills within stream buffers.

C. Installation: After the site has been shaped to the lines and grades as indicated on the Drawings, prepare a friable seedbed relatively free from clods and rocks more than one (1) inch in diameter, and any foreign material that will prevent contact of the mat or blanket to the soil surface. Staple mats or blankets to soil surface following manufacturer's recommendations.

D. Maintenance: In accordance with paragraph 3.19 titled Inspections and Maintenance, all erosion control matting and blankets shall be inspected and maintenance performed, if needed, within 24 hours of inspection, once every seven (7) calendar days, and within 24 hours of a rainfall event that has precipitation of ½ inch or greater. Any dislocation or failure shall be repaired immediately. If washouts or breakage occurs, reinstall the matting or blanket after repairing damage to the slope or ditch. Continue to monitor these areas until they become permanently stabilized.

3.17 ANIONIC POLYACRYLAMIDE (Pm)

A. This section covers the use of the chemical anionic Anionic Polyacrylamide to settle out silt and suspend solids from surface water and ground water prior to discharge. Application of Anionic Polyacrylamide shall utilize a method and amount as

recommended by the manufacturer and approved by the Engineer. Anionic Polyacrylamide may be applied to disturbed areas in either Powder or Liquid/Emulsion form as described herein.

B. Application: Liquid/Emulsion form of Anionic Polyacrylamide shall be applied to disturbed areas at a rate of 0.5 gallons of emulsion to 1000 gallons of water. Powder form of Anionic Polyacrylamide shall be applied at a rate of 4 pounds per acre of disturbed area.

C. Maintenance: Apply additional Anionic Polyacrylamide as authorized or directed by the Engineer.

3.18 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, together with CUMMING UTILITIES shall prepare a Notice of Intent. CUMMING UTILITIES shall submit a properly executed NOI to Georgia EPD at least fourteen (14) calendar days prior to start of land disturbance activities.

3.19 INSPECTIONS AND MAINTENANCE

A. Contractor shall designate a Qualified Person properly certified as such by Georgia Soil and Water Conservation Commission, to perform inspections required by this item. The following areas are to be inspected and maintenance performed, if needed, at least once every seven (7) calendar days and within twenty-four (24) hours of a rainfall event that has a precipitation of ½ inch or greater. Immediate action shall be taken to correct deficiencies to BMPs (Best Management Practices). CUMMING UTILITIES reserves the right to stop all construction activities not related to maintaining BMP's until such deficiencies to BMPs are repaired. Areas to be inspected under this item are:

1. Disturbed areas of the construction site that have not undergone final stabilization.
2. Erosion and sediment control structures.
3. All locations where vehicles enter or exit the site.
4. Material storage and construction lay down areas that are exposed to precipitation and have not been, or will not be finally stabilized for more than seven (7) calendar days.

B. In areas that have been finally stabilized, inspections and, if necessary, maintenance by Contractor shall occur at least once per month for the duration of the contract or project, whichever is longer.

C. During inspections the following shall be observed and appropriate maintenance procedures taken:

1. The conformance to specifications and current condition of all erosion and sediment control structures.
2. The effectiveness and operational success of all erosion and sediment control

measures.

3. The presence of sediments or other pollutants in stormwater runoff at all runoff discharge points.

4. The presence of sediments or other pollutants in receiving waters.

5. Evidence of offsite tracking at all locations where vehicles enter or exit the site.

D. An inspection checklist is included at the end of this item. This checklist must be completed during each inspection, dated, and signed by the Qualified Person conducting the inspection. Completed inspection checklist shall be kept onsite with the Contract Documents and submitted to CUMMING UTILITIES on a monthly basis. The Contractor shall repair deficiencies within twenty-four (24) hours of inspection.

3.20 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 NPDES Permit No. GAR 100002 – Infrastructure, Part IV.D.6. Sampling Requirements, Part IV.E. Reporting, and Part IV.F. 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 County reserves the right to use its own resources to duplicate monitoring and verify the Work required by the Contractor in this section.

C. Payment Procedures: There shall be a separate payment for Work covered under this section titled Monitoring and Reporting including monitoring, sampling, reporting, all labor, materials, and equipment necessary to complete the Work as specified. There shall be no separate payment for monitoring each location in the project that is to be monitored.

3.21 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 CUMMING UTILITIES shall submit a Notice of Termination.

3.22 REMOVAL OF TEMPORARY EROSION AND SEDIMENT CONTROL STRUCTURES

A. At such time that temporary erosion and control structures are no longer required under this item, the Contractor shall notify the Designer, and Engineer of Contractor’s intent and schedule for the removal of the temporary structures, and obtain Designer’s and Engineer’s approval in writing prior to removal. Once the Contractor has received such written approval from the Designer and Engineer, the Contractor shall remove, as approved; the temporary structures and all sediments accumulated at the removed structure shall be returned upgrade. In areas where temporary control structures are removed, the site shall be left in a condition that shall restore original drainage. Such

areas shall be evenly graded and seeded as specified in paragraph 3.13 Disturbed Area Stabilization – Permanent Vegetation (Ds3).

3.23 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

A. Install all erosion and sediment control structures as specified, indicated on the Drawings, or as directed by the Designer, Engineer, or CUMMING UTILITIES, as the first item of Work within a given drainage area. Construction and installation of all erosion and sediment control structures shall begin downgrade of the area

to be disturbed and proceed upgrade. Contractor shall, at all times, maintain all soil erosion and sediment control structures and practices throughout construction and until permanent vegetative 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 United States, the State of Georgia, and/or the local issuing authority, *and* fourteen (14) calendar days have passed since Notice of Intent (NOI) is properly filed with Georgia EPD.

3.24 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.

3.25 PERMITTING

A. Land disturbance activity shall not commence until the Land Disturbance Permit has been issued by the local issuing authority, *and* fourteen (14) calendar days have passed since Notice of Intent (NOI) was properly filed with Georgia EPD.

B. A Certified Design Professional properly certified as such by the Georgia Soil and Water Conservation Commission shall be responsible for performing the following duties with respect to the Erosion and Sedimentation Control Permit.

1. Certified Design Professional shall prepare an Erosion, Sedimentation and Pollution Control Plan (ES&PCP), and shall submit same to the local issuing authority for approval, and shall provide Contractor with three (3) approved copies of the ES&PCP.
2. Engineer shall obtain Land disturbance permits from local governments.
3. The same Certified Design Professional who prepared the ES&PCP shall conduct the initial seven (7) day inspection after initial installation of BMPs.

C. Contractor shall be responsible for performing the following duties with respect to the

Erosion and Sedimentation Control Permit.

1. Contractor shall execute the NOI as "Operator" and submit to CUMMING UTILITIES along with required fees, and CUMMING UTILITIES shall execute the NOI as "Owner" and then properly submit fully executed NOI and the required fees to Georgia EPD. No land disturbance activity shall be started until fourteen (14) calendar days have passed after the Notice of Intent (NOI) is properly submitted to Georgia EPD.
2. Contractor shall employ a Qualified Person who shall perform inspections of BMPs as outlined in NPDES General Permit GAR 100002, Part IV, D.4.
3. Contractor shall employ a Qualified Person who shall gather samples of storm water as outlined in NPDES General Permit GAR 100002, Part IV, D.6., and as further defined in the ES&PCP.

D. Contractor shall employ a Qualified Person who shall prepare, submit and maintain all reporting and report submittal requirements as outlined in NPDES General Permit GAR 100002, Part IV, E. and F.

Cumming Utilities

Erosion and Sediment Control Checklist

Instructions: Complete this checklist at least once per week and within 24 hours of any rainfall greater than ½ inch. Summarize deficiencies on this page (attach additional pages if necessary). Take action to correct problems within 24 hours. Keep this form in the project file.

Inspection Done by: _____ ***Date:*** _____

Item No.	Explanation of Deficiency or Deficiencies	Corrective Action Taken	Date Completed

Temporary Interceptor, Diversion and Perimeter Dikes Check List (Di)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
TDK –1	Installation	Are dikes properly placed to divert water to drainage ditches, sediment basins, or temporary or permanent channels?			
TDK –2	Installation	Are dikes constructed of earth fill free of refuse, such as wire, brush, rocks over 6 inches in diameter, ashes, muck, etc?			
TDK –3	Installation	Have dikes been compacted using construction equipment?			
TDK –4	Installation	Do dikes have a top width of at least 2 feet?			
TDK –5	Installation	Are dikes at least 18 inches above surrounding grade?			
TDK –6	Installation	Are side slopes of dikes 2:1?			
TDK –7	Installation	Have dikes been stabilized with vegetative cover (temporary seeding)?			
TDK –8	Maintenance	Are dikes still 2 feet across top and at least 18 inches high even after weathering?			
TDK –9	Maintenance	Do dikes have vegetative cover?			

Inspection done by:_____Date:_____

Temporary Interceptor, Diversion, and Perimeter Ditches (Di)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
TDD –1	Installation	Are ditches properly placed parallel to, contiguous to, and upslope of temporary dikes?			
TDD –2	Installation	Do ditches have a minimum depth of one (1) foot?			
TDD –3	Installation	Are ditch side slopes 2:1 or flatter?			
TDD –4	Installation	Are ditch sides and bottoms free of projections, trees, brush, stumps, etc?			
TDD –5	Installation	Are ditches stabilized with a vegetative cover?			
TDD –6	Maintenance	Ditch side slopes have not eroded to be steeper than 2:1?			
TDD –7	Maintenance	Are ditches free of sediment and debris?			
TDD –8	Maintenance	Do ditches have vegetative cover?			

Inspection done by:_____Date:_____

Temporary Sediment Barrier - Silt Fence (Sd1-S or Sd1-NS)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
SF –1	Installation	Is silt fence installed at proper intervals? Slope (feet) — Maximum Interval <2% — 100 2% to 5% — 75 5% to 10% — 50 10% to20% — 25 >20% — 15			
SF –2	Installation	Is proper type of silt fence installed? **Type A (Sd1-NS)**- Project duration is 6 months or greater or slope is greater than 3:1. Post spacing 6 feet max. **Type C (Sd1-S)**- Where fill slopes exceed a vertical height of 10ft and the slope is greater than 3:1. Post spacing 4 feet maximum. Has woven wire fabric.			
SF –3	Installation	Has silt fence been installed with a trench 6 inches into the ground?			
SF –4	Installation	Has silt fence post been installed at least 18 inches into the ground?			
SF –5	Maintenance	Has silt fence been in place less than 6 months?			
SF –6	Maintenance	Is silt fence controlling offsite migration of sediment?			
SF –7	Maintenance	Has sediment been removed from the up-slope side of the silt fence in the last 14 days?			
SF –8	Maintenance	Is sediment build-up less than one-half (½) the installed silt fence height?			
SF –9	Maintenance	Is silt fence free of damage, including Tears and holes?			
SF –10	Maintenance	Is silt fence horizontally tight?			
SF –11	Maintenance	Are post intact (unbroken and unbent)?			

Inspection done by:_____Date:_____

Temporary Sediment Barrier – Hay Bales (Sd1)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
HB –1	Installation	Have hay bales been installed at the toe of all slopes higher than 3 feet or steeper than 5:1?			
HB –2	Installation	Have hay bales been installed at a maximum of 100ft intervals, if slope persist?			
HB –3	Installation	Are hay bales wire or nylon bound and rectangular shaped?			
HB –4	Installation	Are hay bales placed end to end with ends tightly abutting adjacent hay bale?			
HB –5	Installation	Are hay bales embedded into the soil a minimum of 4 inches below grade?			
HB –6	Installation	Are hay bales anchored with 2 inch x 2 inch wooden stakes or no. 3 reinforced bars, with a minimum length of 36 inches?			
HB –7	Installation	Are stakes driven in at an angle toward the previously placed hay bale, at least 18” into the ground?			
HB –8	Maintenance	Are hay bales intact?			
HB –9	Maintenance	Are stakes unbroken or unbent?			
HB –10	Maintenance	Is sediment build up less than one half (½) the original bale height?			
HB –11	Maintenance	Has sediment been removed from the upslope side of hay bale in last 14 days?			
HB –12	Maintenance	Have hay bales been installed less than thirty (30) calendar days ago?			
HB –13	Maintenance	Are hay bales in firm contact with ground surface with no undermining of soil?			

Inspection done by:_____Date:_____

Construction Exits (Co)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
CE –1	Installation	Have construction exits been constructed prior to any construction operations at all points where traffic leaves the site to a right-of-way, street, alley, or parking area?			
CE –2	Installation	Are construction exits a minimum of 50 feet long and a right angle to the street, alley, etc?			
CE –3	Installation	Are construction exits a minimum of 20 feet wide?			
CE –4	Installation	Are construction exit pads a minimum of 6 inches in depth?			
CE –5	Installation	Have geotextile underliners been placed under the construction exit pads?			
CE –6	Installation	Have the construction exit pads been constructed of 1 ½ to 3 ½ inch diameter stone?			
CE –7	Maintenance	Are construction exit length, width, and depth being maintained?			
CE –8	Maintenance	Have construction exits been maintained within the last 14 days?			
CE –9	Maintenance	Is geotextile underliner still covered by stone (not visible)?			

Inspection done by:_____Date:_____

Check Dams – Stone (Cd-S)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
CD –1	Installation	Were check dams constructed of appropriate materials? < 2 acres draining graded size 5 to 10 inch diameter stone			
CD –2	Installation	Is center of check dam at least 9 inches lower than the outer edges?			
CD –3	Installation	Is check dam height 2 feet maximum at center of check dam?			
CD –4	Installation	Are side slopes of check dam 2:1 maximum?			
CD –5	Installation	Are check dams properly spaced in series (toe of upstream check dam at same elevation as top of downstream check dam)?			
CD –6	Installation	Do check dams cover entire width of ditch or swale?			
CD –7	Installation	Are check dam heights lower than channel banks?			
CD –8	Installation	Are check dam heights lower than upstream property line elevation?			
CD –9	Maintenance	Are check dam dimensions and slopes being maintained?			
CD –10	Maintenance	Is sediment less than one-half (½) the original check dam height?			
CD –11	Maintenance	Are check dams in good contact with ground surface with no undermining of soil?			

Inspection done by:_____Date:_____

Inlet Sediment Trap (Sd2)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
SD –1	Installation	Are inlet sediment traps constructed around all storm drain inlets that receive runoff from disturbed areas?			
SD –2	Installation	Are sediment traps constructed according to design?			
SD –3	Installation	Do sediment traps provide for a minimum of 1½ feet of sediment storage?			
SD –4	Installation	Are sediment traps self-draining?			
SD –5	Installation	If gravel is used for the filtering media, is it 3 to 6 inches in diameter?			
SD –6	Installation	If baffle box inlet filters were used, are they constructed of 2”x 4” or 4”x 4” posts and 2”x 4” boards?			
SD –7	Maintenance	Does sediment trap have adequate storage volume for subsequent rains?			
SD –8	Maintenance	Are sediment traps intact?			
SD –9	Maintenance	Are wooden components unbroken?			
SD –10	Maintenance	Is gravel overtaken with sediment?			
SD –11	Maintenance	Are filter fabrics free of tears or holes?			

Inspection done by:_____Date:_____

Disturbed Area Stabilization (Ds1, Ds2, Ds3, Ds4)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
VS –1	Installation	Have disturbed areas been stabilized with temporary vegetation and mulched within 24 hours of completion?			
VS –2	Installation	Have disturbed areas awaiting permanent stabilization cover, where suitable growing season is not available, been stabilized with temporary vegetation and/or mulch?			
VS –3	Installation	Was surface prepared for seeding (by scarifying soil a minimum of 1 inch deep)?			
VS –4	Installation	Has seeding been performed according to growing seasons and required mixtures of seed and fertilizer?			
VS –5	Installation	Has mulch been loosely applied, after seeding, to a thickness of 1 ½ to 2 ½ inches?			
VS –6	Installation	Has mulch been retained using an asphaltic emulsion or mechanically tacked?			
VS –7	Installation	For areas which have not received temporary vegetation and have received mulch only: Has dry straw or hay mulch been applied to a thickness of 2 to 4 inches? Has wood waste been applied to a thickness of 2 to 3 inches?			
VS –8	Maintenance	Are stabilized areas intact with no signs of eroded areas?			
VS –9	Maintenance	Do disturbed areas that have been stabilized with mulch have the proper thickness of mulch?			
VS –10	Maintenance	Are previously stabilized areas intact and not in need of touch up seeding or mulching?			

Inspection Done by:_____Date:_____

Storm Drain Outlet Protection (St)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
St –1	Installation	Are storm drain outlet protections constructed around all storm drain outlets?			
St –2	Installation	Are storm drain outlet protections constructed according to design?			
St –3	Installation	Are storm drain outlet protection aprons constructed straight – no bends?			
St –4	Installation	Is geotextile filter fabric present between soil and quarried stone?			
St –5	Installation	Is minimum thickness of stone pad at least 18” thick?			
St –6	Installation	Is apron constructed level (0.0%) grade?			
St –7	Maintenance	Has erosion occurred around or below riprap?			
St –8	Maintenance	Have riprap stones been dislodged?			
St –9	Maintenance	Are filter fabrics free of tears or holes?			

Inspection done by:_____Date:_____

Storm Drain Outlet Protection (St)

Item No.	Installation or Maintenance	Explanation	N/A	Yes	No
Ss –1	Installation	Are mats installed in concentrated flow areas?			
Ss –2	Installation	Are mats installed on slopes steeper than 2½:1 with a height 10 feet or greater?			
Ss –3	Installation	Are mats installed in cuts and fills within stream buffers?			
Ss –4	Installation	Are mats in direct contact with soil surface (no foreign materials between mats and ground)?			
Ss –5	Installation	Are mats stapled to the ground with U-shaped staples having legs at least 6 inches long?			
Ss –6	Maintenance	Do mats show signs of erosion or undermining?			
Ss –7	Maintenance	Are mats dislocated, broken, or washed out?			

Inspection done by:_____Date:_____

END OF SECTION 31 25 00

SECTION 31 50 00

EXCAVATION SUPORT AND PROTECTION

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 Requirements:

1. Section "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
2. Section 31 20 00 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.
3. Section 31 23 19 "Dewatering" for dewatering excavations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
3. Indicate type and location of waterproofing.
4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor and professional engineer.

B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photograph or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.6 FIELD CONDITIONS

A. Interruption of Existing Utilities: 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:

1. Notify Construction Manager no fewer two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

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

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
2. The geotechnical report is referenced elsewhere in Project Manual.

C. Survey Work: 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.

1. Corners: Roll-formed corner shape with continuous interlock.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application 4 inches.

E. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

F. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

G. Tiebacks: Steel bars, ASTM A 722/A 722M.

H. Tiebacks: Steel strand, ASTM A 416/A 416M.

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 construction and finishing of other work is not impeded.

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 vertical edges to form a continuous barrier.

B. 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.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 BRACING

A. Bracing: 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 Architect.
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 is able to withstand lateral earth and hydrostatic pressures.

3.6 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks **regularly** during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.7 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 31 20 00 "Earth Moving."

3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION 31 50 00

SECTION 32 01 19.61

JOINT SEALING IN CONCRETE PAVEMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section includes requirements and specifications for joint/crack sealing in concrete paving.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.4 REFERENCE STANDARDS

A. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants; current edition.

B. ASTM D 5249 – Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints; current edition.

C. ASTM D 5893 – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements; current edition.

D. ASTM D 6690 – Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements; current edition.

PART 2 – PRODUCTS

2.1 MATERIALS – COLD-APPLIED APPLICATIONS

A. Rubberized Joint Sealing Material: Modified ASTM D6690-Type I. Furnish a rubberized joint

sealing material conforming to the following physical requirements:

1. Cone penetration, non-immersed @ 25ºC (77ºF), 150 g, 5s: 50 to 90
2. Flow @ 60ºC (140ºF) for 5 hours: 1.0 cm max.
3. Resilience @ 25ºC (77ºF): 25% to 60%
4. Ductility @ 25ºC (77ºF) (ASTM D 113): 40 cm max.
5. Bond, non-immersed @ -18ºC (0ºF), 100% extension (Specimen thickness 12.7 mm (1/2 inch)): Pass 5 cycles
6. Asphalt compatibility @ 60ºC (140ºF): Pass
7. Sealant life at application temperature: 8 hours min.

B. Urethane Elastomeric Joint Sealants:

1. Acceptable Manufacturers:

   a. Pecora Corp., Harleysville, PA 19438 (800) 523-6688
   b. Sika Corp., Conyers, GA 30013 (770) 760-1300
   c. Tremco, Beachwood, OH 44122 (800) 321-7906

2. Type and Application: One-part nonsag urethane sealant, ASTM C 920. Use for joints in interior and exterior vertical and horizontal surfaces.

C. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

1. Dow Corning Corporation; 888
2. Pecora Corporation; 301 NS.
3. Type and Application: One-part nonacid-curing silicone sealant, ASTM C 920, modulus as required for application. Use for joints in exterior vertical surfaces.
4. Type and Application: One-part mildew-resistant silicone sealant, ASTM C 920. Use for sanitary applications, interior use.

2.2 MATERIALS – HOT-APPLIED APPLICATIONS

A. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.

1. Products: Subject to compliance with requirements, provide the following provide one of the following:

   a. W. R. Meadows, Inc.; Sealtight Hi-Spec Sealtight 3405.
   b. Right Pointe; D-3405 Hot-Applied Sealant.

2.3 PAVING JOINT FILLERS

A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1& Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

B. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

C. Acceptable manufacturers:

1. BASF Master Builders Solutions, Shakopee, MN 55379 (800) 243-6739
2. W.R. Meadows, Cartersville, GA 30120 (770) 386-6440

D. Type: Bituminous fiber

E. Application: Filler for exterior paving joints.

2.4 AUXILLARY MATERIALS

A. Backer Rod: shall comply with joint sealant manufacturer's specification. Backer rod width should be 25% greater than the width of the joint being sealed.

B. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 – EXECUTION

3.2 INSTALLATION

A. The crack shall be blown out with compressed air and cleaned free of dirt, vegetation, debris, and loose sealant. No routing will be required unless specified by the manufacturer. The cracks shall be dried using compressed air with a heat lance when moisture is present. The use of flame cleaning to dry the cracks will not be permitted. Cracks shall be kept clean and dry until sealant is applied.

B. The contractor may install a backer rod in joints that are excessively wide or deep prior to applying the joint sealant to control the amount of joint sealant applied. The backer

rod must meet the requirements and specifications of the joint sealant manufacturer. The optimum joint sealant installation is a 1:1 ratio of width to depth.

C. Crack sealing shall not occur when surface temperature is below 35ºF and the air temperature is below 40ºF.

D. Melt the joint sealant in a conventional double-boiler, oil-jacketed melter-applicator equipped with an agitator and separate control thermometers for both the oil bath and melting vat. Ensure the temperature of the joint sealant does not exceed the manufacturer's maximum temperature (usually 390ºF).

E. The crack shall be filled with joint sealant in accordance with manufacturer's instructions allowing it to penetrate the crack depth.

F. For joints 1/4 inch and larger, the sealant shall be placed slightly below the paving surface.

G. For joints less than 1/4 inch, the sealant shall be placed slightly over full to allow striking off.

H. The sealant on the surface shall be struck off with a squeegee to feather the sealant out to a width of approximately two to three inches.

I. The sealant surface shall be dusted with sand as necessary to prevent tracking in areas that cannot be closed off to traffic until cured.

J. Discard all joint sealant remaining in the melter-kettle at the end of the day unless manufacturer specifically allows the product to be reheated and used again.

K. Contractor, with the Owner Engineer present, shall perform random tests on sealed joints for proper adhesion by inserting a knife or flat object to verify adhesion to the sides of the joint. Cut along both sides of the joint to release a ½ inch long section of sealant. Pull on the sealant to ensure that it is adhered to the existing paving. If joint sealant pulls out, contractor shall remove all unbonded sealant, clean and dry joint sides, and install new joint sealant to all failed joints at no extra cost. Repair all test sections.

END OF SECTION 32 01 19.61

SECTION 32 12 16

REMOVING AND REPLACING PAVEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. The work to be performed under this Section shall consist of removing and replacing existing pavement, sidewalks and curbs in paved areas where necessary for construction of utilities and all other sewer appurtenances and structures.

B. Existing pavement, sidewalks and curbs shall be replaced to the current Fulton County standards or to match existing, whichever is more stringent.

1.2 SUBMITTALS

A. Certificates: Provide certificates stating that materials supplied comply with Specifications. Certificates shall be signed by the asphalt producer and the Contractor.

B. Traffic paint manufacturer's application instructions and a description and other data relative to the Contractor's application equipment and methods shall be submitted to the Owner for approval.

1.3 CONDITIONS

A. Weather Limitations

1. Apply bituminous prime and tack coats only when the ambient temperature has been at least 55^{o} F for 12 hours immediately prior to application.
2. Do not conduct paving operations when surface is wet or contains excess of moisture which would prevent uniform distribution and required penetration.
3. Construct asphaltic courses only when atmospheric temperature in the shade is above 40^{o} F, when the underlying base is dry and when weather is not rainy.
4. Place base course when air temperature is above 35^{o} F and rising.

B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

PART 2 – PRODUCTS

2. 1 MATERIALS AND CONSTRUCTION

A. Graded Aggregate Base Course: Graded aggregate base course shall be of uniform quality throughout and shall meet the requirements of Section 815.01 of the Georgia Department of Transportation Standard Specifications.

B. Black Base: Black base course shall be of uniform quality throughout and shall conform to the requirements of Section 828 of the Georgia Department of Transportation Standard Specifications.

C. Binder Course: The binder course of all paved roadways shall conform to the requirements of Section 400, 12.5 mm Superpave of the Georgia Department of Transportation Standard Specifications.

D. Surface Course: The surface course for all pavement, including prime or tack coat when required by the Owner, shall conform to the requirements of Section 400, 9.5 mm Superpave of the Georgia Department of Transportation Standard Specifications

E. Concrete: Provide concrete and reinforcing for concrete pavement or base courses in accordance with the requirements of the Georgia Department of Transportation Standard Specifications, Section 430. Concrete shall be of the strength classifications shown on the Drawings.

F. Special Surfaces: Where driveways or roadways constructed of specialty type surfaces such as brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar, if not original, materials. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

2.2 TYPES OF PAVEMENTS

A. General:

1. All existing pavement removed, destroyed or damaged by construction shall be replaced with the same type and thickness of pavement as that existing prior to construction, unless otherwise directed by the Owner.
2. Materials, equipment and construction methods used for paving work shall conform to the Georgia Department of Transportation specifications applicable to the particular type required for replacement, repair or new pavements.

B. Aggregate Base:

1. Aggregate base shall be constructed in accordance with the requirements of Section 310 of the Georgia Department of Transportation Standard Specifications.
2. The maximum thickness to be laid in a single course shall be 6 inches compacted. If the design thickness of the base is more than 6 inches, it shall be constructed in two or more courses of approximate equal thickness.

3. After the material placed has been shaped to line, grade and cross-section, it shall be rolled until the course has been uniformly compacted to at least 100 percent of the maximum dry density when Group 2 aggregate is used, or to at least 98 percent of maximum dry density when Group 1 aggregate is used.

C. Concrete Pavement:

1. Concrete pavement or base courses shall be replaced with concrete.
2. The surface finish of the replaced concrete pavement shall conform to that of the existing pavement.
3. The surface of the replaced concrete base course shall be left rough.
4. The slab depth shall be equivalent to the existing concrete pavement or base course, but in no case less than 6-inches thick.
5. Transverse and longitudinal joints removed from concrete pavement shall be replaced at the same locations and to the same types and dimensions as those removed.
6. Concrete pavements or concrete base courses shall be reinforced.

D. Asphaltic Concrete Base, Binder and Surface Course:

1. Asphaltic concrete base, binder and surface course construction shall conform to Georgia Department of Transportation Standard Specifications, Section 400.
2. The pavement mixture shall not be spread until the designated surface has been previously cleaned and prepared, is intact, firm, properly cured, dry and the tack coat has been applied.
3. Apply and compact the base in maximum layer thickness by asphalt spreader equipment of design and operation approved by the Owner.
4. After compaction, the black base shall be smooth and true to established profiles and sections.
5. Apply and compact binder and the surface course in a manner approved by the Owner.
6. Immediately correct any high, low or defective areas by cutting out the course, replacing with fresh hot mix, and immediately compacting to conform and thoroughly bond to the surrounding area.

E. Surface Treatment Pavement:

1. Bituminous penetration surface treatment pavement shall be replaced with a minimum thickness of 1 inch conforming to Section 424, Georgia Department of Transportation Standard Specifications.

F. Gravel Surfaces:

1. Existing gravel road, drive and parking area replacement shall meet the requirements of graded aggregate base course.

2. This surfacing may be authorized by the Owner as a temporary surface for paved streets until replacement of hard surfaced pavement is authorized.

G. Temporary Measures:

1. During the time period between pavement removal and complete replacement of permanent pavement, maintain highways, streets and roadways by the use of steel running plates anchored to prevent movement.

2. The backfill above the pipe shall be compacted, as specified, up to the existing pavement surface to provide support for the steel running plates. All pavement shall be replaced within seven calendar days of its removal.

PART 3 – EXECUTION

3.1 LOCATIONS FOR PAVEMENT REPLACEMENT

A. Pavement shall be removed and replaced with similar type and thickness as the original pavement, for the entire length of pipe laying and up to required trench width as per details shown on the Drawings.

3.2 REMOVING PAVEMENT

B. General: Remove existing pavement as necessary for installing the pipe line and appurtenances.

C. Marking: Before removing any pavement, mark the pavement neatly paralleling pipe lines and existing street lines. Space the marks the width of the trench.

D. Breaking: Break asphalt pavement along the marks using pavement shearing equipment, jack hammers or other suitable tools. Break concrete pavement along the marks by scoring with a rotary saw and breaking below the score by the use of jack hammers or other suitable tools.

E. Machine Pulling: Do not pull pavement with machines until the pavement is completely broken and separated from pavement to remain.

F. Damage to Adjacent Pavement: Do not disturb or damage the adjacent pavement. If the adjacent pavement is disturbed or damaged, remove and replace the damaged pavement.

G. Sidewalk: Remove and replace any sidewalks disturbed by construction for their full width and to the nearest undisturbed joint.

H. Curbs: Tunnel under or remove and replace any curb disturbed by construction to the nearest undisturbed joint.

I. Cutting: Before removing any existing pavement, saw cut the pavement in full thickness.

3.3 REPLACING PAVEMENT

A. Preparation of Subgrade: Upon completion of backfilling and compaction of the backfill, arrange to have the compaction tested by an independent testing laboratory approved by the Owner. After compaction testing has been satisfactorily completed, replace all pavements, sidewalks and curbs removed.

1. The existing street pavement or surface shall be removed along the lines of the work for the allowable width specified for the trench or structure.
2. After the installation of the pipelines and after the backfill has been compacted suitably, the additional width of pavement to be removed, as shown on the Drawings, shall be done immediately prior to replacing the pavement.
3. Trench backfill shall be compacted for the full depth of the trench as specified in Section 31 23 00 of these Specifications.
4. Temporary trench backfill along streets and driveways shall include 6 inches of crushed stone or cherty clay as a temporary surfacing of the trenches.
    a. This temporary surface shall be maintained carefully at grade and dustfree by the Contractor until the backfill of the trench has thoroughly compacted in the opinion of the Owner and permission is granted to replace the street pavement.
5. When temporary crushed stone or chert surface is considered by the Owner to be sufficient surface for gravel pavement, the surface shall be graded smooth and to an elevation that will make the final permanent surfacing level with the adjacent surfacing that was undisturbed.

B. Pavement Replacement

1. Prior to replacing pavement, make a final cut in concrete pavement 12 inches back from the edge of the damaged pavement with a concrete saw.
2. Remove asphalt pavement 12 inches back from the edge of the damaged pavement using pavement shearing equipment, jack hammers or other suitable tools.
    a. Pavement cuts shall be parallel or perpendicular to the road centerline as much as practical.
    b. On parallel installations the final cut shall be long and straight and consistent.
3. Replace all street and roadway pavement as shown on the Drawings. Replace driveways, sidewalks and curbs with the same material, to nearest existing undisturbed construction joint and to the same dimensions as those existing.
4. If the temporary crushed stone or chert surface is to be replaced, the top 6 inches shall be removed and the crushed stone surfacing for unpaved streets or the base for the bituminous surface shall be placed.

5. Following this preparation, the chert or crushed stone base shall be primed with a suitable bituminous material and surfaced with the proper type of bituminous surface treatment.

6. Where the paved surface is to be replaced with asphaltic concrete pavement, concrete pavement or with a concrete base and a surface course, the temporary chert or crushed stone surface and any necessary backfill material, additional existing paving and new excavation shall be removed to the depth and width shown on the Drawings.

    a. All edges of the existing pavement shall be cut to a straight, vertical edge.

    b. Care shall be used to get a smooth joint between the old and new pavement and to produce an even surface on the completed street.

    c. Concrete base slabs and crushed stone bases, if required, shall be placed and allowed to cure for three days before bituminous concrete surface courses are applied.

    d. Expansion joints, where applicable, shall be replaced in a manner equal to the original joint.

7. Where driveways or roadways, constructed of specialty type surfaces, such as brick or stone are disturbed or damaged, these driveways and roadways shall be restored utilizing similar materials.

    a. Where the nature of these surfaces dictate, a specialty contractor shall be used to restore the surfaces to their previous or better condition.

    b. Special surfaces shall be removed and replaced to the limits to which they were disturbed.

C. Pavement Resurfacing:

1. Certain areas to be resurfaced are specified or noted on the Drawings.

    a. After all pipe line installations are complete and existing pavement has been removed and the trench route has been repaired, mill entire area to be resurfaced 1-1/2 inches, then apply tack coat and 1-1/2 inches of 9.5 mm Superpave surface course as specified.

    b. Where pavement to be resurfaced has been damaged with potholes, the Contractor shall remove all existing loose pavement material and fill the hole with black base, as specified, to the level of the existing pavement.

2. Resurfacing limits shall be perpendicular to the road centerline.

3. The limits of resurfacing shall be 10 feet beyond the edge of the pavement replacement on the main road being resurfaced, and to the point of tangency of the pavement on the side streets.

D. Pavement Striping:

1. Pavement striping removed or paved over shall be replaced with the same type, dimension and material as original unless directed otherwise by the Owner.

3.4 SIDEWALK AND CURB REPLACEMENT

A. Construction

1. All concrete sidewalks and curbs shall be replaced with concrete.
2. The Contractor shall restore all curbs and combination curbs and gutters which have been removed or disturbed in the progress of the work. Curbing shall be made to conform accurately in size, line, grade and materials with the adjoining curb.
3. The Contractor shall restore all sidewalks which have been removed or disturbed in the progress of the work.
    a. Sidewalks shall be constructed to the same dimensions and materials as the adjoining sections.
    b. Where necessary to cut a sidewalk, entire sections shall be removed and replaced unless otherwise directed by the Owner.
4. Preformed joints shall be 1/2 inch thick, conforming to the latest edition of AASHTO M59 for sidewalks and AASHTO M 123 for curbs.
5. Forms for sidewalks shall be of wood or metal, shall be straight and free from warp and shall be of sufficient strength, when in place, to hold the concrete true to line and grade without springing or distorting.
6. Forms for curbs shall be metal and of an approved section.
    a. They shall be straight and free from distortions, showing no vertical variation greater than 1/8 inch in 10 feet and no lateral variation greater than 1/4 inch in 10 feet from the true plain surface on the vertical face of the form.
    b. Forms shall be of the full depth of the structure and constructed such as to permit the inside forms to be securely fastened to the outside forms.
7. Wood forms may be used on sharp turns and for special sections as approved by the Owner. Where wooden forms are used, they shall be free from warp and shall be the nominal depth of the structure.
8. All mortar and dirt shall be removed from forms and all forms shall be thoroughly oiled or wetted before any concrete is deposited.

B. When a section is removed, the existing sidewalk or curb shall be cut to a neat line, perpendicular to both the centerline and the surface of the concrete slab.

C. Existing concrete shall be cut along the nearest existing construction joints. If such joints do not exist, the cut shall be made at minimum distances shown on the Drawings.

D. Existing concrete sidewalks and curbs that have been cut and removed for construction purposes shall be replaced with the same width and surface as the portion removed.

E. Sidewalks shall have a minimum uniform thickness of 4-inches. The new work shall be neatly jointed to the existing concrete so that the surface of the new work shall form an even, unbroken plane with the existing surfaces.

F. The subgrade shall be formed by excavating to a depth equal to the thickness of the concrete, plus 2 inches.

1. Subgrade shall be of such width as to permit the proper installation and bracing of the forms.
2. Subgrades shall be compacted by hand tamping or rolling. Soft, yielding or unstable material shall be removed and backfilled with satisfactory material.
3. Place 2 inches of porous crushed stone under all sidewalks and curbs and compacted thoroughly, then finish to a smooth, unyielding surface at proper line, grade and cross section.

G. Joint for Curbs

1. Joints shall be constructed as indicated on the Drawings and as specified. Construct joints true to line with their faces perpendicular to the surface of the structure and within 1/4 inch of their designated position.
2. Thoroughly spade and compact the concrete at the faces of all joints filling all voids.
3. Install expansion joint materials at the point of curve at all street returns. Install expansion joint material behind the curb at abutment to sidewalks and adjacent structures.
4. Place contraction joints every 10 feet along the length of the curbs and gutters.
    a. Form contraction joints using steel templates or division plates which conform to the cross section of the structure.
    b. Leave the templates in place until the concrete has set sufficiently to hold its shape, but remove them while the forms are still in place.
    c. Contraction joint templates or plates shall not extend below the top of the steel reinforcement or they shall be notched to permit the reinforcement to be continuous through the joint.
    d. Contraction joints shall be a minimum of 1-1/2 inches deep.

H. Expansion joints shall be required to replace any removed expansion joints or in new construction wherever shown on the Drawings. Expansion joints shall be true and even, shall present a satisfactory appearance, and shall extend to within 1/2 inch of the top of finished concrete surface.

I. Finishing

1. Strike off the surface with a template and finish the surface with a wood float using heavy pressure, after which, contraction joints shall be made and the surface finished with a wood float or steel trowel.

2. Finish the face of the curbs at the top and bottom with an approved finishing tool of the radius indicated on the Drawings.

3. Finish edges with an approved finishing tool having a 1/4 inch radius.

4. Provide a final broom finish by lightly combing with a stiff broom after troweling is complete.

5. The finished surface shall not vary more than 1/8 inch in 10 feet from the established grade.

3.5 RESTORING DRIVEWAY PAVEMENTS

A. The Contractor shall repair or replace all driveway sections disturbed by the process of the work.

1. Driveways shall be constructed of the same materials and to the same thickness of the adjoining wearing surface.

2. In restoring driveways, the subsoil and foundation material shall be well compacted so as to prevent any future settlement or cracking of the driveway pavement.

3. Where necessary to cut a concrete driveway, the cuts shall be made with a masonry saw providing a smooth, straight line completely across the driveway.

4. Partial cut-outs, crooked cuts or cuts made by any methods other than masonry saw are not permitted. In general, where directed, concrete slab removal shall be made in entire pavement sections to the nearest existing expansion-joint.

B. Driveway and Sidewalk Ramp Openings

1. Provide driveway openings of the widths and at the locations indicated on the Drawings and as directed by the Owner.

2. Provide sidewalk ramp openings as indicated on the Drawings in conformance with the applicable regulations and as directed by the Owner.

C. Concrete shall be suitably protected from freezing and excessive heat. It shall be kept covered with burlap or other suitable material and kept wet until cured. Provide necessary barricades to protect the work. All damage caused by people, vehicles, animals, rain, the Contractor's operations and the like shall be repaired by the Contractor, at no additional expense to the Owner.

3.6 MAINTENANCE

A. The Contractor shall maintain the surfaces of roadways built and pavements replaced until the acceptance of the Project.

1. Maintenance shall include replacement, scraping, reshaping, wetting and rerolling as necessary to prevent raveling of the road material, the preservation of reasonably smooth surfaces and the repair of damaged or unsatisfactory surfaces, to the satisfaction of the Owner.

2. Maintenance shall include sprinkling as may be necessary to abate dust from the gravel surfaces.

3.7 SUPERVISION AND APPROVAL

A. Pavement restoration shall meet the requirements of the regulatory agency responsible for the pavement. Obtain agency approval of pavement restorations before requesting final payment.

B. Obtain the Owner's approval of restoration of pavement, such as private roads and drives, that are not the responsibility of a regulatory agency.

C. Complete pavement restoration as soon as possible after backfilling.

D. Failure of Pavement: Should any pavement restoration or repairs fail or settle during the life of the Contract, including the bonded period, promptly restore or repair defects.

3.8 CLEANING

A. The Contractor shall remove all surplus excavation materials and debris from the street surfaces and rights-of-way and shall restore street, roadway or sidewalk surfacing to its original condition. The right-of-way shall be restored to its original condition.

END OF SECTION 32 12 16

SECTION 32 13 13

CONCRETE PAVING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Section includes preparation of sub-grade to receive Portland cement concrete curbs, gutters, walks, and paving.

B. Section includes Portland cement concrete paving curbs, gutters, walks, form-work, reinforcement, joints, finishing, curing, and concrete testing.

1.2 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 43 00 – Quality Assurance

C. Section 31 2000 – Earth Moving

D. Section 32 01 19.61 – Joint Sealing In Concrete Paving

E. Section 03 30 00 Cast-In-Place Concrete

1.3 SUBMITTALS

A. Shop Drawings: Submit shop drawings of reinforcing steel in accordance with Section 01 33 00 – Submittal Procedures and ACI 301.

B. Test Reports: Submit, at least 15 days prior to start of concrete paving, certified laboratory test reports sufficient to verify compliance of proposed mix design (proportions) with the specifications for type and strength of concrete.

C. Product Data: Provide data on joint filler, admixtures, and curing compound.

D. Samples: Submit two sample panels, 12 x 12 inch in size, illustrating exposed aggregate finish.

E. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

1.4 QUALITY ASSURANCE

A. Perform concrete work in accordance with all applicable requirements of ACI 301 except as modified in this Section.

B. Keep copy of ACI 301 in field office for duration of project.

1.5 REFERENCE STANDARDS

A. AASHTO M 233 – Standard Specification for Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete; current edition.

A. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; current edition

B. ACI 301 – Specifications for Structural Concrete; current edition.

C. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; current edition.

D. ACI 305 – Guide to Hot Weather Concreting; current edition.

E. ACI 306 – Guide to Cold Weather Concreting; current edition.

F. ASTM A 615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; current edition.

G. ASTM A 1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; current edition.

H. ASTM C 31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field; current edition.

I. ASTM C 33 – Standard Specification for Concrete Aggregates; current edition.

J. ASTM C 39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; current edition.

K. ASTM C 94 – Standard Specification for Ready-Mixed Concrete; current edition.

L. ASTM C 143 – Standard Test Method for Slump of Hydraulic-Cement Concrete; current edition.

M. ASTM C 150 – Standard Specification for Portland Cement; current edition.

N. ASTM C 171 – Standard Specification for Sheet Materials for Curing Concrete; current edition.

O. ASTM C 173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; current edition.

P. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; current edition.

Q. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; current edition.

R. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete; current edition.

S. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; current edition.

T. ASTM C 685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; current edition.

U. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); current edition.

V. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; current edition.

PART 2 – PRODUCTS

2.1 CEMENT

A. Use one brand and type of cement throughout project unless otherwise specified.

B. Cement: ASTM C 150 Normal - Type I or III Portland type, gray color.

C. Fine- and Coarse-Mix Aggregates: ASTM C 33.

D. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Fly Ash: ASTM C 618, Class C or F. Maximum 15% of cementitious material by weight.

B. Calcined Pozzolan: ASTM C 618, Class N maximum 10% of cementitious material by weight.

C. Silica Fume: ACI 211.1 Maximum 5% of cementitious material by weight.

D. Add air-entraining agent to obtain total air content in accordance with ACI 301.

E. Use ASTM C494 type A or D water reducer when required.

F. Use no [other] admixtures unless written approval is obtained from Project Engineer.

G. Chemical Admixtures: ASTM C 494, Type A - Water Reducing, Type C - Accelerating, and Type G - Water Reducing, High Range and Retarding.

H. Do not use chemicals that will result in soluble chloride ions in excess of 0.1% by weight of cement.

I. Admixtures containing calcium chloride will not be permitted.

2.3 CONCRETE

A. Weight: Normal weight.

B. Strength for Concrete Paving: 4000 psi, 28-day compressive strength; minimum cement requirements in accordance with ACI 301, except not less than 520 pounds of cement per cubic yard.

C. Strength for Concrete Curbs, Gutters, and Walks: 3000 psi, 28-day compressive strength; minimum 480 pounds of cement per cubic yard.

D. Water-Cement Ratio: Maximum 40% by weight.

E. Slump: In accordance with ACI 301, except three inch max. design slump for concrete paving; tolerance as specified in ACI 301.

F. Total Air Content: 4%, determined in accordance with ASTM C 173.

2.4 REINFORCING STEEL

A. Reinforcing Bars: 60 ksi yield grade, ASTM A 615; deformed carbon steel [bars.]

B. Steel-Welded Wire Reinforcement: Plain type, ASTM A 1064 in flat sheets; unfinished.

C. Dowels: ASTM A 615 Grade 40 (280); deformed carbon steel bars; unfinished finish.

2.2 JOINT MATERIALS

D. Expansion Joint Filler: ASTM D1751.

E. Expansion Caps: Metal; specifically designed to allow longitudinal dowel movement of not less than 1-1/4 inches in expansion joints.

F. See Section 320119 – Joint Sealing in Concrete Paving.

2.3 ACCESSORIES

G. Anti-Spalling Treatment: 50% (by volume) boiled linseed oil and 50% (by volume) mineral spirits, complying with AASHTO M233.

PART 3 – EXECUTION

3.2 PREPARATION OF SUBGRADE

A. Ensure compaction and grading of subgrade are in accordance with Section 313000 – Earthwork before placing concrete paving.

B. Remove loose material from compacted subgrade surface prior to placing concrete.

C. Moisten base to minimize absorption of water from fresh concrete.

D. Coat surfaces of manhole frames with oil to prevent bond with concrete pavement.

E. Notify Project Engineer a minimum of 24 hours prior to commencement of concreting operations.

3.3 PLACING, FINISHING AND CURING

A. Perform concrete work in cold and hot weather as specified in ACI 301 and in accordance with the recommendations of ACI 306 and ACI 305.

B. Finishing: Float finish in accordance with ACI 301. Then finish by drawing a stiff bristled broom or burlap across concrete surface. Finish to surfaces of uniform texture free from depressions (“birdbaths”).

C. Curing: Begin curing concrete paving immediately after finishing. Use one of the following procedures:

1. Ponding or continuous sprinkling.
2. Application of absorptive mats or fabric kept continuously wet.
3. Continuous application of steam (not exceeding 150°F) or mist spray.
4. Application of waterproof sheet materials conforming to ASTM C171 and application of a curing compound conforming to ASTM C309. Apply a white tinted solution at the rate specified by the manufacturer.

3.4 PLACING JOINTS

A. Place joints true to line with face perpendicular to surface of concrete.

B. Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such placements terminate at expansion joints.

C. Construct weakened plane, contraction joints utilizing either or both of the following methods:

1. Saw cut contraction joints to a depth equal to one-quarter of concrete paving thickness with powered saws using 3/16 inch blade as soon as surface will not be torn, abraded, or otherwise damaged by cutting action. Cut completely through concrete at edge of form.
2. For Concrete Paving up to 10 Inches Thick: Saw cut contraction joints with G-2000 system, Model 270. The first saw-cut contraction joints are to be to a depth equal to one-quarter (1/4) of concrete paving thickness using a 3/16 inch blade. The second saw-cut at joint location is to be one inch minimum depth using a 1/4 inch blade within 2 hours after final finish.

D. Construct expansion joints with one end of dowel set in expansion cap to allow longitudinal movement, as indicated.

E. Place expansion joint filler between abutting concrete curbs, gutters, walks, manholes, catch basins, and inlets, unless otherwise indicated.

3.5 ANTI-SPALLING TREATMENT

A. Apply treatment to concrete paving no sooner than 28 days after placement.

B. Thoroughly clean paving of oil, dirt, debris, and other foreign material. Ensure paving is dry prior to application.

C. Apply treatment to paving evenly at a rate of 40 square yards per gallon. Allow paving to dry completely and apply a second coat at a rate of 60 square yards per gallon.

3.6 TOLERANCES

A. Elevation: Plus 1/2 inch of required elevations, except that no difference in elevation will be permitted at joints with other surfaces intended to be at same elevation as Portland cement concrete paving.

B. Thicknesses indicated are minimum in-place thickness.

C. Finished Surfaces: True planes within 1/4 inch in 10-footas determined by a 10-foot straightedge placed anywhere on the paving in any direction.

3.7 FIELD QUALITY CONTROL

A. Perform concrete testing in accordance with Section– Quality Requirements.

B. Contractor to engage independent testing laboratory to perform tests for strength, slump, and air content as follows:

1. Test specimens for compressive strength in accordance with ASTM C31 and C39.
2. Make at least one strength test for each 100 cubic yards, or fraction thereof, of each mix design of concrete placed in any one day.
3. Test three specimens for each strength test consisting of one specimen tested at seven days and two specimens tested at 28 days. Make a fourth specimen for each strength test. Retain in reserve for later testing if required.
4. Determine slump of the concrete for each strength test in accordance with ASTM C143.
5. Determine air content of the concrete for each strength test in accordance with ASTM C173, for concrete requiring air-entraining agent.

3.8 COLD AND HOT WEATHER CONCRETING

A. Follow recommendations of ACI 305 when concreting during hot weather.
B. Follow recommendations of ACI 306 when concreting during cold weather.
C. Do not place concrete when base surface temperature is less than 40° F, or surface is wet or frozen.

END OF SECTION 32 13 13

SECTION 32 13 73

CONCRETE PAVING AND JOINT SEALING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes requirements and specifications for joint sealants in concrete paving.

1.2 RELATED SECTIONS

A. Section – Miscellaneous Work and Clean Up

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. Federal Specifications (Fed. Spec.):

SS-S-200	Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, For Portland Cement Concrete Pavement
SS-S-1401B	Sealing Compound, Hot-Applied, for Concrete and Asphalt Pavements
SS-S-1614	Sealing Compound, Jet Fuel Resistant, & Am-1 Hot-Applied, One Component, For Portland Cement and Tar Concrete Pavements

1.4 SAMPLING AND TESTING JOINT SEALERS

A. Submit a 5 gallon sample of joint sealer plus primer to the Waterways Experiment Station in Vicksburg, Mississippi for testing. The Contracting Officer will provide details of the submittal requirements. The Contractor is advised that this testing will require approximately 45 days to complete. Joint sealers will be tested by the Government, and no material shall be used prior to receipt by the Contractor of written notice that the material is acceptable. The cost of the first test of samples from each lot of joint sealer will be borne by the Government. If the sample fails to meet specification requirements, the material represented by the sample shall be replaced. Retests of rejected material shall be at the expense of the Contractor.

1.5 SUBMITTALS

A. Certified Test Reports: Submit copies of reports for the following materials:

1. Bond Breakers
2. Primers
3. Joint Seals

B. Equipment: Submit a list and description of the equipment to be used and a statement from the supplier of the joint sealant that the proposed equipment is acceptable for installing the specified sealant.

C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with recommendations of the manufacturer of sealing compounds, submit catalog data and copies of recommendations, and a Material Safety Data Sheet (Department of Labor Form OSHA-20 or comparable form) to identify toxic components such as asphalt and coal tar products.

D. Samples: Submit samples of sealant materials and bond breakers.

1.6 DELIVERY AND STORAGE

A. Inspect materials delivered to the site for visible damage, and unload and store with a minimum of handling. Joint materials shall be delivered in original sealed containers and shall be protected from freezing or overheating. Provide jobsite storage facilities capable of maintaining temperature ranges within manufacturers recommendations.

1.7 WEATHER LIMITATIONS

A. Do not proceed when weather conditions detrimentally affect the quality of forming joints and applying joint sealants. Apply sealants only if the atmospheric temperature is at least 40 degrees F in the shade and is rising. Surfaces shall be dry and component materials shall be protected from free moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Joint Sealant

1. Fed Spec. SS-S-200, Type H&M.
2. Fed Spec. SS-S-1614.
3. Fed Spec. SS-S-1401.

B. Primer: Select concrete primer recommended by the manufacturer of the proposed liquid joint sealant.

C. Bond Breakers:

1. Blocking Media (Roving): Compressible, nonshrink able, nonreactive with joint sealant, such as, upholstery cord, cotton, and jute, or polyethylene foam rod, all free of oils or bitumens. Minimum width shall be 1/8 inch greater than joint width.
2. Separating Tape: Polyethylene or polyester tape, 3 mil minimum thickness, or masking tape, rubber tape, or other barrier sheet, nonreactive, non-absorptive, adhesive-back tape, 1/8-inch wider than the nominal width of the joint. Select type of tape that will not bond to joint sealer.

2.2 EQUIPMENT

A. General Requirements: Furnish all equipment, tools, and accessories necessary to clean existing joints and install liquid joint sealants. Maintain machines, tools, and other equipment in proper working conditions at all times.

B. Joint Cleaning Equipment:

1. Routing Tool: To remove old sealant from joints, select routing tool that is adjustable to varying widths and depths required, but not wider than the existing joint, and of such dimension that will not strike and damage the sides of joints. V-shaped tools, or rotary impact routing devices shall not be permitted. The equipment shall be capable of maintaing accurate cutting depth and width control.
2. Concrete Saw: Self-propelled power saw with diamond saw blades designed for sawing hardened concrete, to reface, widen, or deepen existing joints as specified without damaging the sides, bottom, or top edge of joints. Blades may be single or gang type with one or more blades mounted in tandem for fast cutting. Select saw adequately powered and sized to cut specified opening with not more than two passes of the saw through the joint.
3. Sandblasting Equipment: Commercial type capable of removing residual sealer, oil, or other foreign material which may prevent bond of new sealer. Equipment shall include an air compressor, hose and nozzles of proper size, shape, and opening. Attach an adjustable guide to the nozzle or nozzles that will hold the nozzles aligned with the joint to effectively and efficiently clean without damage to concrete edges, except for slight edge chipping of deteriorated concrete edges, inherent in this type of cleaning existing weathered concrete. Adjust the height, angle of inclination, or size of nozzles to sandblast the joint faces and not the bottom of the joint.
4. Air Compressor: Potable air compressor capable of operating the sandblasting equipment and capable of blowing out sand, water, dust adhering to sidewalls of concrete, and other objectionable materials from the joints. The compressor shall furnish oil free air at a pressure not less than 90 psi and a minimum rate of 150 cubic feet of air per minute at the nozzles, and free of oil.

5. Jet Waterblasting: High-pressure water jet machine shall include compressor, pressure pumps, hose, water jets, and controls capable of discharging water up to 10,000 psi pressure at 22 gallons per minute. Use adjustable nozzles to control nozzle pressure between 7,000 and 10,000 psi. Select high-pressure hoses with burst pressures from 20,000 psi to 30,000 psi.
6. Vacuum Sweeper: Self-propelled, vacuum pickup sweeper capable of completely removing all loose sand, water, joint material, and debris from pavement surface.
7. Hand Tools: When approved, hand tools such as brooms and chisels may be used in small areas for removing old sealant from joints and repairing or cleaning the joint faces.

C. Joint Sealing Equipment:

1. Hot-Poured Liquid Sealant: Install hot-poured sealant materials with unit applicators which will heat and extrude the sealant. Equip the mobile units with double-wall agitator type kettles with an oil medium in the outer space for heat transfer, a direct-connected pressure-type extruding device with nozzle or nozzles shaped for insertion in the joints to be filled, and positive devices for controlling the temperature of oil and sealer. Design the applicator so that the sealant will circulate through the delivery hose and return to the kettle when not sealing a joint. Insulate the applicator wand from the kettle to the nozzle. Select dimensions of nozzles such that the tip will easily feed sealant into the void space of the joint. Equip the nozzle tip with a metal cross-bar to assure that the top of the sealant fed into the joint is level and within the indicated tolerance below the pavement surface.
2. Cold-Applied Liquid Sealant: Select equipment designed to mix and install cold-applied joint sealant materials.

    a. Applicators: The equipment shall deliver two semifluid components to a portable mixer through a hose at a controllable present ratio by positive displacement with an accuracy within 5 percent, plus or minus, for the quantity of each component. Equip the reservoirs for each component with mechanical agitation devices that will maintain the components in uniform condition without entrapping air.
    b. Incorporate provisions to permit thermostatically controlled indirect heating of the components when required; however, immediately prior to proportioning and mixing, do not permit the temperature of either component to exceed the temperature recommended by the manufacturer.
    c. Screens: Provide screens with openings not exceeding 1/2-inch square at the top of each reservoir to eliminate any foreign particles or partially polymerized material that would clog fluid lines or otherwise cause misproportioning or improper mixing of the two components. The equipment shall be capable of intimately mixing the two components through a range of application rates of 10 to 60 gallons per hour and through a range of pressures from 50 to 1,500 psi, as required by material, climatic, or operating conditions.Equipment shall deliver a homogeneous product from the mixer to the nozzle without undue elapsed time which tends to tear down the

molecular structure of the chemically reacting components while passing through the mixer.

d. Equipment Selection: Select supply lines and nozzles for easy removal and cleaning and for readily accommodating nozzles of different types and sizes and as many as may be required for the various operations. Select dimensions of the nozzle such that the tip of the nozzle will easily feed sealant into the void space of the joint. Equip the nozzle tip with a metal cross-bar to assure that the top of the sealant fed into the joint is level and within the indicated tolerance below the pavement surface.

PART 3 - EXECUTION

3.1 JOINT PREPARATION

A. General Joint Preparation: Unless otherwise indicated, saw, clean and reseal all joints. Do not proceed with final cleaning operations by more than one working day in advance of sealant. Thoroughly clean the joints by removing existing joint sealing compound, sealants, dirt, and other foreign material with the equipment specified herein, but not limited thereto. Cleaning procedures which damage joints or previously repaired patches by chipping or spalling will not be permitted. Remove existing sealant to the required depth. Precise shape and size of existing joints vary, and the conditions of the joint walls and edges vary and include but are not limited to rounding, square edges, sloping, chips, voids, depressions, and projections.

B. Removal of Existing Material: Remove from the joint faces major portion of the existing sealants by using the specified routing tool. After cutting free the existing sealant from both joint faces, remove the sealant to the depth required to accommodate the bond breaking material and to maintain the specified depth for the new sealant to be installed. For expansion joints, remove existing sealant to a depth of not less than the indicated depth. one inch. If existing preformed expansion-joint material is more than one inch below the surface of the pavement, remove the existing sealant to the top of the preformed joint filler. For joints other than expansion joints, remove in-place sealant to the depth of grooves, which are 1 inch, plus or minus 1/4 inch. At the completion of routing operations clean the pavement surface with vacuum sweeper and clean the joint opening by blowing with compressed air, or water blast. Protect previously cleaned joints from being contaminated by subse quent cleaning operation.

C. Refacing of Joints: When other cleaning methods are unsatisfactory to widen the joint space to the width and depth as shown reface concrete joint walls. Refacing shall be by use of a power-driven concrete saw specified herein to remove all residual sealant and a minimum of concrete. Removal shall provide exposure of newly clean concrete. Remove all burrs and irregularities from sides of joint faces. Immediately after sawing each joint, thoroughly clean the saw cut and adjacent concrete surface. Flush with water under pressure, simultaneously blowing the water out with compressed air until all debris is

removed from the joint. Protect adjacent previously cleaned joint spaces from receiving water and debris during the cleaning operation.

1. Joint Widening (Except Expansion Joints): Saw joints having grooves less than 3/8-inch wide and less than one inch deep to a minimum width of 1/2 inch and to the minimum depth, as shown.

D. Final Cleaning of Joints:

1. Expansion Joints: Following removal of existing sealant, and immediately before resealing, thoroughly clean the joints by sandblasting until all concrete surfaces in the joint space are free of sealing compound, sealants, dust, dirt, water and any other foreign materials which would prevent bonding of new sealants to the concrete. Use sand particles of the proper size and quality for the work. Perform sandblasting with the specified nozzles, air compressor, and other appurtenant equipment. Position nozzles to clean the joint faces and not the bottom of the joint. Make as many passes of the sandblast nozzle along the joint as required for proper cleaning. Immediately prior to sealing the joint, blow out the joint spaces with compressed air until completely free of sand, water, and dust. Joints shall be dry before installation of joint sealant. Replace expansion joint filler material damaged in performing the work with new materials of the same type and dimensions as the existing material, or with appropriate blocking material.
2. Joints (Except Expansion Joints):

    a. Waterblast Cleaning: By use of the specified high-pressure water jets, complete the final cleaning of the joints by removing all evidence of the old sealant from the joint faces and from the pavement surface for a distance of one inch from the edges of the joint. Remove the sealant for the depth of the groove or void space. In any event, remove the sealant to the depth required to accommodate any bond breaker to be used and to maintain the above depth for the newly installed sealant. Select the specified high-pressure water jet machines and accessories for water blasting the joints. If required, attach an adjustable guide to the nozzle or nozzles that will support and align the nozzle with the joint at the required height above the joint faces. The tip of the nozzle shall be capable of simultaneously fanning the water toward each joint face at approximately 15 degrees with the pavement surface. Operate the water blast equipment in accordance with the manufacturer's printed instruction, and if necessary, adjust the equipment to secure through cleaning. Make as many passes as necessary for proper cleaning. Control the flow of water and prevent any operation that will damage the concrete joints or float the concrete slabs. After water blasting, blow out the joints with compressed air using the specified air compressors to remove all debris and moisture and to ensure that the joints are dry and clean at the time of sealing.

E. Bond Breaker: At the time the joints receive the final cleaning and are dry, install bond breaker material as indicated in the bottom of the joint with a steel wheel or other approved device.

1. Blocking Media (Roving) (Except for Expansion Joints): When the existing sealant has been removed to a depth greater than required, plug or seal off the lower portion of the groove by installing the specified blocking media.
2. Separating Tape: When the existing sealant has been removed to a depth less than one inch and the bottom of the joint opening has been formed by saw-cuts, or previously installed joint water stops, insert the specified tape to prevent contact of the newly installed sealant with the existing sealant, joint filler, or groove bottom.

F. Rate of Progress: The final stages of joint preparation, which include placement of bond breakers, if required, shall be limited to only that lineal footage of joint that can be resealed during the same workday.

G. Disposal of Debris: Sweep from pavement surface to remove excess joint material, dirt, water, sand, and other debris by vacuum sweepers or hand brooms. Remove the debris immediately in accordance with Section – Miscellaneous Work and Clean Up.

3.2 PREPARATION OF SEALANT

A. Hot-Poured Type: Heat hot-poured sealing materials in accordance with safe heating temperature ranges recommended by the manufacturer. Sealant that has been overheated or subjected to heating for over 3 hours or that remain in the applicator at the end of the day's operation shall be withdrawn and wasted. Heat the sealant in the specified equipment.

B. Cold-Applied: Arrange for the inspection of the sealant components and containers before the materials are installed. Reject materials which contain water, hard caking of any separated constituents, nonreversible jell, or other unsatisfactory conditions such as settlement of constituents into a soft mass that cannot be readily and uniformly remixed in the field with simple tools. In conformance with the manufacturer's recommendations, mix the individual components in the separate shipping containers before transferring the components to the appropriate reservoirs of the application equipment. Thoroughly mix the components to ensure homogeneity of the components and the incorporation of all constituents at the time of transfer. If necessary, for remixing prior to transfer, warm the components to a temperature not exceeding 90 degrees F by placing the components in heated storage or by other approved methods. In no case shall the components be heated by direct flame or in single-walled, non-oil-bath heating kettles. [hand mixing of cold-applied two component sealant may be done at the option of the Contractor for sealants conforming to Fed. Spec. SS-S-200, Type H.

3.3 INSTALLATION OF SEALANT

A. Time of Application: Seal the joints immediately following the final cleaning and placing of the bond breakers, if these are required. Commence sealing the joints when the walls of the concrete joint are dust-free and dry, and when both the atmospheric temperature and pavement temperature within the joint opening are above 40 degrees F and rising. If the above conditions cannot be met, or if rains interrupt sealing operations, reclean the open joints prior to installing the sealant.

B. Sealing the Joints: Do not install joint sealant until the joints to be sealed have been inspected and approved. Install bond breaker just prior to pouring sealant. Fill the joints with sealant from the bottom up until the joints are uniformly filled solid from bottom to top using the specified equipment for the type of sealant required. Fill the joints to as shown in the plans below the top of the pavement within the tolerances as shown, and without formation of voids or entrapped air. Except as otherwise permitted, tool the sealant immediately after application to provide firm contact with the joint walls and to form the indicated sealant profile below the pavement surface. Remove excess sealant that has been inadvertently spilled on the pavement surface. When cold-applied sealants are placed, each day check hourly the proportioning capability of the equipment to determine that the present volume output for each component is being maintained. The material used for these checks may be returned to the proper component reservoir. In no case shall cold-applied sealants be installed using gravity methods and pouring spouts, except for approved hand mixing methods. When a primer is supplied or recommended by the manufacturer of a cold-applied sealant, apply the primer evenly to the joints faces in accordance with the manufacturer's recommendations. Check the sealed joints frequently to assure that the newly installed sealant is cured to a tack-free condition within 3 hours. The new sealant shall be protected from rain during the curing period.

C. Trial Joint Installation: For each type of joint, as a preliminary to the resealing of joints for the entire project, the Contractor shall select a length of not less than 600 feet of joint in an approved location and clean and seal the joint with the specified sealant in the manner proposed for resealing joints for the entire project. Following the sealing of the 600-foot trial length, and before any other joint sealed, the trial joint installation shall be inspected to determine That the sealant and installation meet the requirements specified herein. If it is determined that the cleaning method, material, or installation do not meet the requirements, remove the material and again clean and prepare the joint for resealing. After approval of a 600-foot trial joint, clean and seal all other joint grooves in the same manner and subject to approval.

D. Safety Provisions: In accordance with the provisions of the contract respecting "Accident Prevention," the Contractor shall take appropriate measures to control worker exposure to toxic substances during the work. Provide personnel protective equipment as required. Material Safety Data Sheets (Department of Labor Form OSHA-20 or comparable form) shall be available on the site. Sandblasting operations shall conform with Environmental Protection regulations.

3.4 TRAFFIC CONTROL

A. During the protection, curing, and maintenance periods recommended by the manufacturer, do not permit vehicular or heavy equipment in the area of the joints. At the end of the curving period, light local traffic may be permitted on the pavement if approved.

3.5 ACCEPTANCE

A. Joint sealer that fails to bond firmly to the joint walls, or is gummy, or fails in cohesion, or shows excessive air voids, blisters, surface defeats, swelling, or deficiencies, or is not properly recessed within the indicated tolerances, shall be rejected. Such unacceptable sealer shall be removed and the joint recleaned and resealed in accordance with the specification. This removal and reseal work shall be done promptly by and at the expense of the Contractor.

END OF SECTION 32 13 73

SECTION 32 16 13

SIDEWALKS, CURBS, AND GUTTERS

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
1.5	Quality Control
2.1	Materials
3.1	Preparation
3.2	Joints
3.3	Finishes
3.4	Construction
3.5	Curing

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all Work in accordance with the Contract Documents.

1. Paving Removal (02 41 13.13)
2. Cast-In-Place Concrete (03 30 00)
3. Excavation and Fill (31 23 00)
4. Removing and Replacing Pavement (32 12 16)
6. Roadway Construction (34 71 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. Forsyth County Department of Transportation Standard Specifications.

1. Where section numbers are identified throughout this specification, the reference is to the Georgia Department of Transportation Standard Specifications Construction of Roads and Bridges, latest edition.

1.3 WORK INCLUDED

A. The Contractor shall furnish all labor, equipment, and materials necessary to install concrete sidewalks, curbs, and gutters as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

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.

1.5 QUALITY CONTROL

A. Tolerances: Construct concrete surfaces within 0.05 feet of the indicated elevation on the Drawings and deviating not more than 3/8-inch from a ten-foot straightedge placed anywhere on the surface.

B. Strictly conform to requirements for compaction of subgrade, air entrainment of concrete, and curing of concrete.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete: All concrete shall be Class “A” in accordance with GDOT Standard Specifications Section 500.03, and have a 28-day compressive strength of 3,000 psi.

B. Joint filler: Nonextruding joint material, furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate and compact the subgrade as specified in Section 31 23 00, true to the grade and cross section as indicated on the Drawings.

B. Place forms or extrusion machine guides to exact elevation and location specified. Visually check forms and machine guides and adjust where necessary to ensure smooth curves and transitions in grade. Provide close spacing on curves to maintain a smooth curve.

3.2 JOINTS

A. Expansion Joints: Install expansion joints at intervals as indicated on the Drawings, but not exceeding 40 feet for walks and curbs, and wherever new concrete abuts existing construction. Additional joints are to be placed at tangent points of circular curbs and other places where stresses may develop.

B. Contraction (Control) Joints:

1. Sidewalks: Cut joints with a saw immediately after concrete reaches adequate hardness to allow sawing contraction joints in sidewalks shall be 3/4 inch deep and spaced at a distance equal to the width of the walk.

2. Curb and Gutter: For formed work, use full depth steel forms to achieve contraction joints. For extruded work, cut contraction joints with a saw

immediately after concrete reaches adequate hardness to allow sawing. Contraction joints in curb and gutters shall be 1 ½ inch deep and spaced at 10 feet intervals.

3. Concrete flatwork: Cut joints with a saw immediately after concrete reaches adequate hardness to allow sawing. Contraction joint depth shall be ¼ of the concrete thickness. Spacing and pattern shall be as indicated on the Drawings, or as directed by the Engineer.

C. Pre-molded expansion joint filler must be cut to full cross section of the proposed construction and shall extend the full depth, width, and length of the construction. Trim expansion joint material protruding after the concrete has been finished as directed by the Engineer or CUMMING UTILITIES. All longitudinal expansion joints shall be placed as indicated on the Drawings.

3.3 FINISHES

A. Pedestrian and Wheelchair Ramps: Non-slip finish.

B. All others: Broom finish.

3.4 CONSTRUCTION

A. Place forms true to line, grade, and cross section, as indicated on the Drawings.

B. Brace forms adequately before placing the concrete. Place concrete in forms and thoroughly tamp, vibrate or work it into all corners, removing air pockets. Allow forms to remain in place until the concrete has set sufficiently to hold its shape.

C. Begin each phase of screed, float, and trowel and finish work as soon as the concrete can be properly worked. Completely finish sidewalks and flat work with forms in place.

D. Remove forms on the front face of curbs as soon as the concrete will hold its shape and finish the face. For gutters, a strike-off template of the form and shape of the gutter shall be used to shape the top surface of the gutter. Round top edges of curb and edges of gutter using a radius tool matching the radius indicated on the Drawings. Finish the edges where templates have been removed or expansion joint material has been placed with an edging tool with a radius of not over 1/4-inch, and then all lines or marks removed with a wet brush.

E. Remove all tool marks with a wetted brush or wooden float, and the finished surface shall present a uniform and smooth appearance.

3.5 CURING

A. Cure concrete as specified in Section 03 30 00 Cast-In-Place Concrete.

END OF SECTION 32 16 13

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section includes requirements and specifications for chain link fencing and gates for site perimeter and areas requiring separation.

1.2 RELATED SECTIONS

A. Section 03 30 00 – Cast-In-Place Concrete

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

1.4 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers that have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.5 REFERENCE STANDARDS

A. AASHTO M181/ASTM A 392 – Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; current edition.

B. ASTM A 491 – Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; current edition.

C. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; current edition.

D. ASTM A 1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; current edition.

E. ASTM F 567 – Standard Practice for Installation of Chain-Link Fence; current edition.

F. ASTM F 668 – Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric; current edition.

G. ASTM F 934 – Standard Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials; current edition.

H. ASTM F 1083 – Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; current edition.

I. CID A-A-1928 – Padlocks; current edition.

J. Fed.Spec. RR-F-191/2 – Fencing, Wire and Post, Metal (Chain-Link Fence Gates); current edition.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Steel Chain-Link Fence Fabric:

1. Mesh and Wire Size: Two inch mesh, 0.148 inch diameter (9 gage).
2. Zinc-Coated Steel Fabric: ASTM A392 hot dipped galvanized before or after weaving, Class 2 - 2.0 oz/ft², 9 gauge
3. Aluminum–Coated Steel Fabric (Aluminized): ASTM A 491.
4. Polymer Coated Steel Fabric: ASTM F 668, wire gauge specified is that of the metallic coated steel core wire, Class 1 extruded, Color: black in compliance with ASTM F 934.

B. Framework:

1. Acceptable Types:

   a. ASTM F 1083, galvanized round steel pipe, standard weight (schedule 40), hot dip galvanized with not less than 1.8 oz./sq. ft.
   b. Round steel pipe from ASTM A 1011 or ASTM A 653 steel; 50,000 psi minimum yield strength; in compliance with AASHTO M181 requirements for interior and exterior coatings.

2. Line Posts: 2.375 inches O.D.
3. End, Corner, and Pull posts: 2.875 inches O.D.
4. Gate Posts (for nominal width of gate leaf):

   a. Up to 6 feet – 2.875 inches O.D.
   b. 6 to 13 feet – 4.000 inches O.D.
   c. 13 to 18 feet – 6.625 inches O.D.

d. Over 18 feet – 8.625 inches O.D.

5. Top Rail: 1.66 inches O.D.; not less than 18 foot lengths; with expansion type couplings not less than six inches long; provided with means for securely attaching top rail to each end, corner, pull, and gate post.
6. Brace Rail: 1.66 O.D.; trussed to line posts with 3/8 inch diameter rod and adjustable tightener.

C. Post Tops: Combination with single, 45-degree barbed wire supporting arm; furnished with opening to permit passage of top rail; hot dip galvanized steel; fitted with clips or other means for attaching three rows of barbed wire; of sufficient strength to withstand a weight of 250 pounds applied at outermost end.

D. Couplings, Bands, Clips, Wire Ties, Tension Bars, Fasteners, and Fittings: Hot dip galvanized steel.

E. Bottom Tension Wire: 7 gage, coil-spring wire, galvanized or aluminized steel.

F. Barbed Wire: 12-1/2 gage wire, two (2) strands, with 14 gage, 4-point barbs at not more than five inches o.c.; galvanized or aluminized steel.

G. Concrete: As specified in Section 03 30 00 – Cast-In-Place Concrete.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions and approved submittals. Comply with ASTM F 567. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Install posts to depth to avoid frost heave.

B. Cut pipe with pipe-cutters only. Cutting with backsaws is not acceptable. Tack weld gates for strength. Use spring-loaded latches, not yokes.

C. Restore or replace damaged components. Clean and protect work from damage.

END OF SECTION 32 31 13

SECTION 32 73 00

WETLANDS PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Definitions
1.4	Overview
1.5	Work Included
1.6	Submittals
3.1	Conditions Applicable Only to Specific Nationwide Permits
3.2	Construction Activities Near Wetlands
3.3	Enforcement

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Clearing and Grubbing (31 11 00).
2. Temporary Fencing (31 13 11).
3. Excavation and Fill (31 23 00).
4. Erosion and Sedimentation Controls (31 25 00).
5. Turf and Grasses (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.

1.3 DEFINITIONS

A. Contractor: For the purposes of this item, the term "Contractor" is synonymous with Contractor, General Contractor, Discharger, Operator, and Primary Permittee, as used in the Individual, or Nationwide Permit language, as it relates to laws, rules, regulations, ordinances and other wetland protection and permitting references.

B. 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.

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 GAR 100002, Part I.B. shall apply in this section.

1.4 OVERVIEW

A. Contractor shall meet minimum requirements for complying with Federal Register Code of Federal Regulations (CFR) 33, Part 330.
   1. Wetlands: Wetland areas shall be indicated on the Drawings, or identified in the field by the Designer.
   2. Compliance: In accordance with General Conditions of the NWP, the Contractor shall comply with the current Section 33 CFR Part 330, as well as all laws, rules, regulations, ordinances, and/or other requirements concerning wetlands protection and permitting designated and established by the United States, the State of Georgia, or the City of Cumming.
   3. Time: Land disturbing activities are not authorized to begin until after all required wetland permits and buffer variances are obtained from the U.S. Army Corps of Engineers (USACE), the State of Georgia, and City of Cumming.
   4. For the purposes of this item, the Designer may at any time during the project, provide direction.

1.5 WORK INCLUDED

A. The Contractor is responsible for using construction techniques and implementing other measures that ensure compliance with all of the general and specific conditions prescribed in Federal Register 33 CFR Part 330, as prescribed in the Final Notice of Issuance, Reissuance, and Modification of Nationwide Permits (NWPs) in the Federal Register (Volume 61, Number 241) on December 13, 1996, or most current version. In addition, the Contractor is also responsible for complying with all project-specific conditions indicated on the Drawings, and in the Contract Documents. This item covers the Work necessary to comply with the above referenced regulations before, during, and after construction in, and adjacent to, wetlands. The Contractor shall furnish all material and labor necessary for compliance with Federal Register 33 CFR Part 330 under this item.

1.6 SUBMITTALS

A. Contractor shall submit, 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, the following documents for approval:

Spill Plan: The Contractor shall prepare a Spill Plan that addresses handling of fuels, lubricants, chemicals, and other toxic materials that may be used. The plan must include:

1. Identification of refueling sites.
2. Identification of storage areas for fuels, lubricants, chemicals, and other toxic materials.
3. Procedures for refueling and maintaining pontoon-mounted backhoes, trench dewatering pumps, and other similar equipment used in wetlands or other water bodies.
4. Contingency plan for cleaning up spills and other releases of fuels, lubricants, chemicals, and other toxic materials.

B. Certification of Completed Work: The Contractor shall submit to the Engineer a signed certification regarding the completed Work and any required mitigation. CUMMING UTILITIES shall forward this certification to the USACE with the authorization letter. The certification shall include:

1. A statement that the authorized Work was done in accordance with the USACE authorization, including any general or specific conditions,
2. A statement that any required mitigation was completed in accordance with the permit conditions if completed by the Contractor,
3. The signature of the Contractor certifying the completion of the Work and mitigation if completed by the Contractor.

PART 2 - PRODUCTS – (NOT USED)

PART 3 - EXECUTION

3.1 CONDITIONS APPLICABLE ONLY TO SPECIFIC NATIONWIDE PERMITS

A. The following sections of this item describe conditions specific to certain NWPs. Based on the permits granted by the USACE for a specific project, CUMMING UTILITIES or Designer shall notify the Contractor of the applicability of the following terms and conditions:

1. **NWP 12 - Utility Line Activities**: The Contractor shall meet the following requirements for those areas covered under NWP 12.
   a. Temporary Sidecast: Material resulting from trench excavation may be temporarily sidecast (for up to three months) into waters of the United States, provided that the material is not placed in such a manner that it is dispersed by currents or other forces. CUMMING UTILITIES cannot extend this time period without approval from the USACE. As such, the Contractor must provide the Engineer with at least 30 days notice if an extension to the temporary side-cast time limit is desired (such a request does not guarantee approval of the extension, and does not release the Contractor from the responsibility to comply with the requirements of this Section).

b. Disturbed Area: The area of Waters of the United States that is disturbed must be limited to the minimum necessary to construct the utility line.
c. Trench Backfill: In wetlands, the top 6" to 12" of the trench must be backfilled with topsoil from the trench, unless otherwise authorized by the USACE, the State of Georgia, and the Designer.
d. Excess Material: Excess material must be removed to upland areas within 24 hours of completion of construction.
e. Exposed Slopes: Any exposed slopes and stream banks must be stabilized within 24 hours of completion of the utility line.

2. **NWP 13 - Bank Stabilization**: The Contractor shall meet the following requirements for those areas covered under NWP 13:
   a. Material Placement: No material may be placed in excess of the minimum needed for erosion protection.
   b. Bank Stabilization: The bank stabilization activity must be less than 500 feet in length.
   c. Activity Limitations: The activity must not exceed an average of one (1) cubic yard per running foot placed along the bank below the plane of the ordinary high water mark or the high tide line.
   d. Special Aquatic Site: No material may be placed in any special aquatic site, including wetlands.
   e. Flow Into and Out of Wetlands: No material may be of the type, or placed in any location or in any manner so as to impair surface water flow into or out of any wetland area.
   f. Erosion by Flows: No material may be placed in a manner that shall be eroded by normal or expected high flows (properly anchored trees and treetops may be used in low energy areas).

3. **NWP 14 – Linear Transportation Projects**: The Contractor shall meet the following requirements for those areas covered under NWP 14.
   a. Width of Fill: The width of the fill must be limited to the minimum necessary for the actual crossing.
   b. Limitations of Fill: A fill placed in Waters of the United States must be limited to a filled area of no more than 1/3 acre. Furthermore, no more than a total of 200 linear feet of the fill for the roadway can occur in special aquatic sites, including wetlands.
   c. Crossing Design: The crossing must be culverted, bridged, or otherwise designed to prevent the restriction of, and to withstand, expected high flows, and to prevent the restriction of low flows and the movement of aquatic organisms.
   d. Single Project: The crossing, including all attendant features, both temporary and permanent, must be part of a single and complete project for crossing of Waters of the U.S.
   e. Prevention of Sedimentation: The crossing must be constructed in such a manner so as to preclude sedimentation of downstream areas.

4. **NWP 18 - Minor Discharges**: The Contractor shall meet the following requirements for those areas covered under NWP 18.

a. Quantity of Discharged Material: The quantity of discharged material and the volume of the excavated area cannot exceed 25 cubic yards below the plane of the ordinary high water mark.
b. Special Aquatic Site: The discharge cannot cause the loss of more than 1/10 acre of a special aquatic site, including wetlands. This acreage limitation includes the filled area, and excavated area, plus special aquatic sites that are adversely affected by flooding and special aquatic sites that are drained so that they would no longer be Waters of the U.S. as a result of the project.

5. **NWP 33 - Temporary Construction, Access and Dewatering**: The Contractor shall meet the following requirements for those areas covered under NWP 33:
   a. Downstream Flows: Appropriate measures must be taken to maintain normal downstream flows and to minimize flooding.
   b. Placement of Fill: Fill must be of materials, and placed in a manner, such that it shall not be eroded by expected high flows.
   c. Dredged Material: The use of dredged material may be allowed only if authorized by the Engineer after consultation with the USACE, the State of Georgia, and the Designer to determine adverse effects on aquatic resources.
   d. Temporary Fill: Temporary fill must be entirely removed to upland areas, or dredged material returned to its original location, following completion of the construction activity, and the affected areas must be restored to the pre-project conditions.
   e. Cofferdams: Cofferdams cannot be used to dewater wetlands or other aquatic areas so as to change their use.
   f. Navigable Waters: Structures located in navigable Waters of the United States must not be left in place after cofferdams are removed, unless authorized by the Engineer after obtaining a Section 10 Permit.

6. **NWP 35 - Maintenance Dredging of Existing Basins**: The Contractor shall meet the following requirements for those areas covered under NWP 35.
   a. Dredged Material: Dredged material must be disposed of at an upland site.
   b. Siltation Control: Proper siltation control measures must be used.

3.2 CONSTRUCTION ACTIVITIES NEAR WETLANDS

A. The Contractor shall complete the following:
   1. Marking of Locations: Wetland locations affected by the project shall be permanently marked (surveyed, staked, and flagged) so that inadvertently removed markers can be relocated. The marking shall be clearly visible to all site personnel and equipment operators. Markings shall be maintained during the construction period.
   2. Access: All site personnel, including all equipment operators, shall use pre-designated access and egress points to the site and pre-designated access roads within the construction site. No access or egress point shall be located in a wetland or other Waters of the United States. Access roads through wetlands

and other Waters of the United States shall be limited to those approved by the USACE, State of Georgia, and the Designer.

3. Staging Areas: All staging areas, spoil storage areas, and additional work areas shall be placed at least 50 feet from wetlands and other water bodies. No clearing of vegetation between these areas and adjacent wetlands is permitted.
4. Right-of-Way Stabilization: Dirt, rock fill, tree stumps, brush, rip rap, or other material that would not promote a natural system shall not be used to stabilize a right-of-way.
5. Equipment: Low-ground-weight equipment shall be used, or conventional equipment shall be operated from mats or other approved bedding material in wetlands and other water bodies.
6. Trench Breakers: Trench breakers shall be constructed or the bottom of the trench shall be sealed with approved material in areas where the trench could drain adjacent wetlands or other water bodies.
7. Equipment, Fuel, and Hazardous Material Storage: Equipment, fuels, and hazardous materials shall be stored at least 100 feet from wetlands and other water bodies. In addition, land-based equipment shall not be refueled or maintained within 100 feet of a wetland or other water body.
8. Sediment and Erosion Control: Appropriate sediment and erosion control devices shall be installed and maintained to prevent sediment or other materials from reaching adjacent wetlands and water bodies. All exposed soil and other fills, as well as any Work below the ordinary high water mark, must be permanently stabilized at the earliest practicable date. Erosion and sediment control devices shall be installed in advance of the start of construction and shall be maintained in accordance with Specification Section 31 25 00 Erosion and Sedimentation Controls.
9. Crossings: Wetland and water body crossings shall be limited to the minimum size required to safely construct the project. Crossings shall be constructed perpendicular to the water body channel, unless prior approval for other methods is obtained from the Engineer, the USACE, the State of Georgia, and the Designer.
10. Flow in Water Bodies: Flows in all water bodies affected by a project shall be maintained at all times unless prior approval is obtained from the Engineer, the USACE, the State of Georgia, and the Designer.
11. Water Quality Standards: State water quality standards in streams and other water bodies affected by or adjacent to the project area shall be maintained in accordance with Georgia EPD Section 4 of Georgia's Rules and Regulations for Water Quality Control (Chapter 391-3-6-.03). Water quality in adjacent waterways shall be maintained as specified by the Engineer, the USACE, the State of Georgia, and the Designer.
12. Schedule: All wetland and water body crossings shall be completed using a compressed schedule to minimize disturbance in these areas.
13. Temporary Roads and Bridges: Temporary roads and bridges shall be removed as soon as the wetland or water body permanent crossing has been constructed and the project has been completed.

14. Metropolitan River Protection Act: The terms, provisions, and requirements of the Metropolitan River Protection Act shall be abided by at all times.
15. Restoration: Disturbed areas shall be restored through seeding and planting of trees and shrubs as directed by the Engineer, the USACE, the State of Georgia, and the Designer. Liquid and granular fertilizers shall not be spread within 25 feet of the stream bank.
16. Long-Term Maintenance: The site shall be inspected as specified by the Engineer, the USACE, the State of Georgia, and the Designer to assure re-establishment of vegetation.
17. Topsoil: Topsoil shall be segregated from spoil and stored within sediment-filtering enclosures. Topsoil shall be backfilled into the top 6-12 inches of any trench through wetlands.
18. Access Barriers: Barriers shall be installed to prevent access to the site and any adjacent rights-of-way by off-road vehicles.
19. Navigation: No activity may cause more than a minimal adverse effect on navigation.
20. Maintenance: Any structure or fill authorized by the Permit shall be properly maintained, including maintenance to ensure public safety.
21. Aquatic Life Movements: No activity may substantially disrupt the movement of those species of aquatic life indigenous to the water body, including those species which normally migrate through the area, unless the activity's primary purpose is to impound water. The Contractor shall not construct perennial water body crossings from March 1 through May 30 unless otherwise authorized by the USACE, the State of Georgia, and the Designer.
22. Regional and Case-by-Case Conditions: The activity must comply with any regional or case-by-case conditions which may have been added by the USACE.
23. Wild and Scenic Rivers: No activity may occur in a component of the National Wild and Scenic River system, or in a river officially designated by Congress, as a study river for possible inclusion in the system.
24. Tribal Rights: No activity or its operation may impair reserved tribal rights, including but not limited to, reserved water rights and treaty fishing and hunting rights.
25. Endangered Species: No activity is authorized under any NWP which is likely to jeopardize the continued existence of a threatened or endangered species, or a species proposed for such designation as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species.
26. Historic Properties: No activity which may affect historic properties listed, or eligible for listing in the National Register of Historic Places, is permitted unless authorized by CUMMING UTILITIES, State Historic Preservation Office (SHPO), the USACE, the State of Georgia, and the Designer (33 CFR part 325, appendix C).
27. Discharge of Dredged or Fill Material: The following conditions apply to activities that involve the discharge of dredged or fill material into waters of the U.S.:

a. Water Supply Intakes: No discharge of dredged or fill material may occur in proximity to a public water supply intake except where the discharge is for repair of the public water supply intake structures and/or adjacent bank stabilization.
b. Suitable Material: No discharge of dredged or fill material may consist of unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.) and material discharged must be free from toxic pollutants in toxic amounts (as defined in section 307 of the Clean Water Act).
c. Spawning Areas: Discharges in spawning areas during spawning seasons must be avoided to the maximum extent practicable. The Contractor shall not construct perennial water body crossings from March 1 through May 30 unless otherwise authorized by CUMMING UTILITIES, USACE, the State of Georgia, and the Designer.
d. Obstruction of High Flows: Discharges must not permanently restrict or impede the passage of normal or expected high flows or cause the relocation of the water (unless the primary purpose of the fill is to impound waters) unless authorized by CUMMING UTILITIES, the USACE, the State of Georgia, and the Designer.
e. Adverse Effects from Impoundments: If the discharge creates an impoundment of water, the accelerated passage of water and/or restriction of its flow shall not adversely affect the aquatic system unless authorized by CUMMING UTILITIES, the USACE, the State of Georgia, and the Designer.
f. Waterfowl Breeding Areas: Discharges into breeding areas for migratory waterfowl must be avoided unless authorized by CUMMING UTILITIES, the USACE, the State of Georgia, and the Designer.
g. Removal of Temporary Fills: Any temporary fills must be removed in their entirety and the affected areas returned to their preexisting elevation.

3.3 ENFORCEMENT

A. The Contractor is responsible for conducting any restoration and/or paying any fine resulting from a violation of the requirements of these specifications or of an applicable permit or regulatory requirement (including work outside an easement). This responsibility is in effect even if the action is initially directed at CUMMING UTILTIES.

END OF SECTION 32 73 00

SECTION 32 91 13

SOIL PREPARATION FOR LANDSCAPING

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 planting soils and layered soil assemblies specified by composition of the mixes.

B. Related Requirements:

1. Section 31 11 00 "Clearing and Grubbin" for topsoil stripping and stockpiling.
2. Section 32 92 00 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 32 93 00 "Plants" for placing planting soil for plantings.

1.3 ALLOWANCES

A. Preconstruction and field quality-control testing is part of testing and inspecting allowance.

1.4 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by the following:

a. University of Georgia Soil, Plant & Water Laboratory
2400 College Station Road
Athens, GA 30602-9105
soiltest@uga.edu

b. Local UGA Extension Office : 1-800-ASK-UGA1

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

1. Notify Owner seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by by Contractor under the direction of the testing agency.

1. Number and Location of Samples: Minimum of ONE soil sample representative per acre from varied site locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: Per testing laboratory directions.
3. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis according to standard laboratory protocol by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.

4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
5. Topsoil and/or planting soil stockpile(s) shall be formed under normal industry standards. Stockpile height shall not exceed highest point of lifting mechanism of equipment (maximum height:" 72 inches; maximum width: 12") creating the stockpile. Stockpile will be considered defective if equipment drives or otherwise compacts stockpile. Do not stockpile within protection zones.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in quantities recommended by the testing agency to produce planting soil.

C. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of loam soil according to USDA textures; and modified to produce viable planting soil.

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of **6** percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
3. Unacceptable Properties: Clean soil of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of **8** percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 2 inches in any dimension.

4. Amended Soil Composition: Blend imported, unamended soil with soil amendments and fertilizers in the quantities recommended by the testing agency to produce the planting soil.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone or mollusk shells.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves and other green waste (grass clippings, twigs, green food waste).
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 50 to 60 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 2-inch sieve.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 8 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. 110Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

a. Mix lime and/or sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

C. Application: Spread planting soil to total depth of 8 inches but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Lifts: Apply planting soil in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments and fertilizer (excluding compost), if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. Mix lime and/or sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 6 inches to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.7 FIELD QUALITY CONTROL

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

B. Perform the following test:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass compaction tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.8 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.9 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 32 91 13

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
1.5	Warranty
2.1	Seed
2.2	Sod
2.3	Topsoil
3.1	Preparation of Seeded or Sodded Areas
3.2	Seeding and Sod Replacement
3.3	Sod Removal/Replacement
3.4	Topsoil
3.5	Mulching
3.6	Watering
3.7	Maintenance

A. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Exploratory Excavations (02 32 19).
2. Removal of Construction Material (02 42 11)
3. Clearing and Grubbing (31 11 00)
4. Excavation and Fill (31 23 00).
5. Erosion and Sedimentation Controls (31 25 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.

1.3 WORK INCLUDED

A. The Contractor shall furnish all labor, equipment, and materials necessary to properly restore all ground surfaces, irrespective of the type, which may be disturbed in the progress of Work required under this contract.

B. These items shall include in general, but without limitation, the spreading of topsoil, fertilizing, seeding, sod placement/replacement, and mulching required to restore disturbed areas as necessary for the proper completion of the Work as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES. It is the intent of these specifications to place seed on all disturbed, non-established areas (i.e. cross- country easements, pasture, etc.); and to place topsoil and sod on all disturbed, established, improved areas (i.e. lawns or other well improved grass areas) that existed as such prior to construction. All disturbed areas are to be restored to same or better general conditions than existed prior to commencement of the Work. Items covered under this section are considered as permanent restoration. Areas disturbed outside the lines and limits of the right-of-way and easements indicated on the Drawings shall be restored at the expense of the Contractor, unless directed otherwise by CUMMING UTILITIES.

C. Standard Specifications: The requirements of the manual for Erosion and Sediment Control in Georgia, latest edition, shall apply as applicable.

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.

B. Submittals shall include, but not be limited to product data for seed, fertilizer, agricultural limestone, vegetative mulch, sod and topsoil.

C. The Contractor shall submit plans showing in detail, the type, location, fertilizer ratios, and percentage cover of all seeding and sodding to be used in construction.

1.5 WARRANTY

A. All plantings, seeded or sodded, shall be guaranteed for a period of one (1) year after Final Completion of the project. Any areas showing evidence of settlement or loss of topsoil shall be rebuilt and replanted as required. Any plantings that are dead or dying during the Warranty Period must be replaced, and at Contractor's expense.

PART 2 - PRODUCTS

2.1 SEED

A. Seed shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seeds shall be furnished in sealed standard containers. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows:

1. Seed Type — Percent

K31 Fescue	95
Material other than grass seed	5
Total	100

B. The aggregate percent of material other than grass seed shall include all non-viable seed, chaff, bulbs, live seed of crop plants other than those specified above, harmless inert matter, and weed seed not exceeding 1.0% by weight of pure live seed and other material in the mixture.

C. Commercial fertilizer shall be composed of a formula of 20-12-10 and shall conform to applicable Georgia fertilizer laws. It shall be uniform in composition, dry, and free flowing and shall be delivered to the site in the original unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer, which becomes caked or otherwise damaged making it unsuitable for use, shall not be accepted.

D. Agricultural limestone shall be an acceptable grade of ground limestone, ground dolomite, or a mixture of limestone and dolomite meeting the following physical and chemical requirements:

1. Gradation

Standard Sieve Size	Maximum Percent (%) Retained
No. 8, maximum	10
No. 100, maximum	75

E. The vegetative mulch shall be the cereal straw from stalks of oats, rye, wheat, or barley. The straw shall be free of prohibited weed seeds and shall be relatively free of all other noxious and undesirable seeds. The straw shall be clean and bright, relatively free of foreign material and be dry enough to spread properly. If the above straw specifications cannot be met practicably, the foliage of the following plants may, with CUMMING UTILITIES's approval, be substituted: Smooth Brome, Timothy, Orchard Grass, Red Canary Grass, Tall Fescue, Red Top, Millet, Blue Stem, Indian Grass, Red Clover, White Clover, Alfalfa, Crimson Clover, Birds Foot Trefoils, and Vetch. The foliage shall be taken relatively free of noxious and undesirable seeds and foreign material. The asphalt emulsion shall be SS-1, SS-1h, CSS-1 or CSS-1h conforming to the requirements of AASHTO M140-70 or AASHTO M208-72.

2.2 SOD

A. Turfgrass Sod: Complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species: Bermudagrass, Carpetgrass, Axonopus, Centipedegrass, St. Augustinegrass, and Zoysiagrass.

C. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. Full sun: Kentucky bluegrass, a minimum of three cultivars.

2. Sun and partial shade: Proportioned by weight as follows:

a. 50 percent Kentucky bluegrass.
b. 30 percent Chewings Red Fescue.
c. 10 percent Perennial Ryegrass.
d. 10 percent Redtop.

3. Shade: Proportioned by weight as follows:
a. 50 percent Chewings Red Fescue.
b. 35 percent Rough Bluegrass.
c. 15 percent Redtop.

2.3 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7.4 percent organic material minimum, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

2. The Contractor shall furnish topsoil free from objectionable materials such as hard clods, stiff clay, sods, hardpan, partially disintegrated stone, plant stumps, large roots, litter, or other materials that are not integrally a natural component of good agricultural soils and which are harmful to or unnecessary for successful plant growth.

PART 3 - EXECUTION

3.1 PREPARATION OF SEEDED OR SODDED AREAS

A. The sub grade for the areas to be seeded or sodded shall be brought to a uniform grade, free of large stones. Topsoil shall be uniformly graded, trimmed, and raked free from unsuitable material, ridges, bumps, or depressions. Over this area, spread agricultural lime at the rate of 50 pounds per 1000 square feet, and spread fertilizer uniformly on the surface of the ground at the rate of 35 pounds per 1000 square feet. Mix the lime and fertilizer uniformly into the top four (4) inches of the soil by suitable harrows, rotary tillers, or other approved equipment.

3.2 SEEDING AND NEW SOD PLACEMENT

A. Sod of the same species as existing grass shall be placed on all established lawns and other established, improved grass areas, as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES. If sod species required is out of season at time of placement, seeding may be allowed as a temporary measure, and then only with Contractor obtained written permission from the affected property owner and approval from CUMMING UTILITIES, until such time as the sod species is in season and will be placed at that time. Sod shall be carefully placed and rolled to ensure good soil contact

B. Seed may be placed on all non-established, disturbed areas, as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

C. Seeding shall be performed using a properly proportioned mixture of inoculated seed approved for use in The Piedmont Region "Zone One" as detailed in the Manual for Erosion and Sediment Control in Georgia. Seeding shall only be permitted during the planting season listed for The Piedmont Region. All seeded areas shall be uniformly mulched immediately after seeding.

D. The Contractor shall be responsible for maintaining all planted areas including, watering, and reseeding defective area until a stand of grass covering ninety percent (90%) of the entire stabilized area is established, and Final Acceptance of the Work by the Engineer is obtained. Areas showing evidence of settlement or loss of topsoil shall be rebuilt and reseeded as required.

E. Any deviations from grass species as specified, as indicated on the Drawings, or differs from existing grass; or alternatives proposed due to unavailability of seasonal grasses; or inappropriateness of sod or seeding due to the time of year; must be presented to, and approved by CUMMING UTILITIES, along with written approval by property owner obtained by Contractor.

3.3 EXISTING SOD REMOVAL AND REPLACEMENT

A. On existing, well-established "sod" type lawns and other improved, well-established grass areas, in lieu of placing new sod, existing sod/grass may be removed and replaced at completion of construction in that area. Existing sod/grass shall be carefully removed, kept watered and alive, and replaced after backfilling has been properly completed. Sod replacement shall be performed using sod of type and grade of that which was disturbed. Sod shall be carefully placed and rolled to ensure good soil contact.

3.4 TOPSOIL

A. The topsoil shall be of sufficient thickness that when spread and compacted, a minimum of four (4) inches shall be available. The Contractor shall furnish natural topsoil of a good condition and tillable structure. Obtain topsoil as borrow from an outside source and from piles of uniform texture, drainage, and other characteristics so as to constitute a homogenous soil meeting the requirements of the Georgia Department of Transportation. Do not place topsoil containing frost or in muddy conditions. If utilizing existing material obtained from the initial excavation of the worksite for reuse as top soil, the Contractor must first obtain approval from CUMMING UTILITIES construction material testing representative as to suitability of its content, including approval of location and method of storage of topsoil for reuse.

3.5 MULCHING

A. Uniformly mulch all seeded areas in a continuous blanket immediately after seeding. Apply the mulch so as to permit some sunlight to penetrate and the air to circulate and

at the same time shade the ground, reduce erosion, and conserve soil moisture. Approximately 25 percent of the ground shall be visible through the mulch blanket.

B. Hold mulch on slopes greater than 3 to 1 ratio in place by the use of an approved mulch binder. Thoroughly mix binder and apply with the mulch. Apply emulsified asphalt or cutback asphalt at the approximate rate of 5 gallons per 1,000 square feet as required to hold the mulch in place.

C. Cover structures, poles, fence, and appurtenances if the mulch binder is applied in such a way that it would come in contact with or discolor the structures.

D. Apply mulch and binder by suitable blowing equipment at closely controlled application rates.

3.6 WATERING

A. Maintain the proper moisture content of the soil to insure adequate plant growth until a sat- isfactory stand is obtained. If necessary, perform watering to maintain an adequate water content in the soil.

B. Accomplish watering by hoses, tank truck, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.7 MAINTENANCE

A. After the grass has grown to a height of 2 inches and before final acceptance, apply one ad- ditional application of nitrogen at the rate of 50 lbs/acre.

B. Apply nitrogen with mechanical hand spreaders or other approved spreaders capable of uni- formly covering the grassed areas. Do not apply nitrogen on windy days or when the foli- age is damp. Do not apply nitrogen between October 15 and March 15 except in Zone 4. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

C. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.

D. Immediately reseed areas that show bare spots.

E. Apply fertilizer at approximately 600 lbs/acre each spring after initial plant establishment until Final Acceptance.

F. The Engineer may require replanting of an area that shows unsatisfactory growth for any reason at any time. Except as otherwise specified or permitted, prepare replanting areas ac- cording to the Specifications as if they were the initial planting areas.

END OF SECTION 32 92 00

SECTION 32 92 10

TREE REMOVAL AND PROTECTION

PART 1 – GENERAL

1.1 SCOPE

A. The work specified in this Section includes furnishing all labor, equipment and material required to locate, identify, verify condition and remove or protect existing trees as shown on the Drawings and/or as directed by the Owner.

B. The Contractor shall install orange tree protection fencing (barrier) around each tree to be protected, as shown on the Drawings and as ordered by the Owner.

C. No trees or vegetation shall be removed except as specifically exempted or approved by the Owner.

1.2 REFERENCE

A. "Trenching and Tunneling near Trees," by James R. Fazio. Published by the National Arbor Day Foundation.

B. "Tree Preservation Ordinance and Administrative Guide Lines," Fulton County, latest edition.

1.3 QUALIFICATIONS

A. Contractor shall have on staff for the project at least one person with a minimum of 5 years' experience as nurseryman in planting and protecting trees.

1.4 SUBMITTALS

A. Contractor shall walk the site with local City's Arborist, to understand (in more detail than shown on the Drawings) the scope and requirements of tree protection for this Project.

B. Prepare a Tree Protection Work Plan describing how tree protection will be handled during installation of the water lines. The Work Plan shall include, but is not limited to:

1. Confirmation of identification of specimen trees (shown on the Drawings) and other trees to be protected.
2. Scope of general protection of trees within right-of-ways and along the sewer line trench alignment.

3. Determination of drip line limits of protected trees and approximate free bore lengths.
4. Scope of general protection of trees outside right-of-ways but in close proximity to work areas.
5. Extent of approved or required tree limb cutting and trimming to make space for work area.
6. Extent of approved or required tree root cutting, if necessary within trench area.
7. Confirmation of the type of protective fencing, other protective measures as required, and installation details.

C. Contractor shall submit five copies of the Tree Protection Work Plan to the Owner for approval. Contractor shall not begin any field activity prior to approval of this Work Plan by the Owner and City Arborist.

PART 2 – PRODUCTS

2.1 PRODUCTS

A. Protective Fencing

1. Orange Safety Fencing: Minimum 4 feet in width and shall be made of high density polyethylene resin, extruded and stretched to provide a highly visible bright orange, non-fading fence.
   a. The fabric shall remain flexible from -60° F to 200° F and shall be inert to most chemicals and acids.
   b. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs. and a maximum opening size of 2 inches.
   c. The fabric shall have minimum tensile yield strength (horizontal) of 2,000 psi and ultimate tensile strength of 2,680 psi.
2. The fencing material shall be supported by steel pipe tee posts or U posts, that are minimum 5 ½ feet in height and spaced no more than 8 feet on centers. The fabric shall be secured to post by bands or wire ties.

B. Warning Signs: A weather proof warning sign shall be prominently displayed on each tree protection fence at 20-foot intervals. The sign shall be minimum 8.5-inches X 11-inches and clearly state in half inch tall letters: “Warning – Tree Protection Zone”.

C. Silt Fence (Type S): Silt fence shall be installed 2 feet from the outside of the tree protection fence where required or directed by the Owner and City Arborist.

D. Trunk Protection: When directed by the City Arborist, the tree trunk protection shall be provided using either 2x4-inch or 2x6-inch planking or plastic strapping.

E. Tree Dressing: Dressing of any damaged areas shall be accomplished using any approved asphaltic tree wound paint immediately after damage occurs.

PART 3 – EXECUTION

3.1 EXECUTION

A. Protective Fencing:

1. All trees and shrubs in the proximity of the construction site shall be carefully checked for damage prior to initiation of any construction activity.
2. All individual trees, shrubs and natural areas scheduled for preservation shall be protected during construction with temporary fencing as indicated on the Drawings or directed by the City Arborist.
3. Protective fences shall be installed prior to the start of any site preparation work (clearing, grubbing or grading) and shall be maintained in functioning condition throughout all phases of the construction project.
4. Protective fence locations in close proximity to intersecting streets or drives shall adhere to the site distance requirements.

B. Protective fences shall be constructed around trees to be protected, at the locations (typically the outer limits of the Critical Root Zone) and with materials indicated on the Drawings to prevent the following:

1. Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.
2. Root zone disturbances due to grade changes greater than 6-inch cut or fill or trenching not reviewed and authorized by the City Arborist or the Owner.
3. Damage to exposed roots, trunks or limbs by mechanical equipment.
4. Other activities detrimental to trees such as chemical storage, concrete truck cleaning and fires.

C. Exceptions to the installation of protective fences at the tree drip lines may be permitted in the following cases:

1. Where there is to be an approved grade change, impermeable paving surface, tree well or other such site development, the fence shall be erected approximately 2 to 4 feet beyond the areas of disturbance.
2. When permeable paving is to be installed within a tree drip line, the fence shall be erected at the outer limits of the permeable paving area prior to any site grading so that this enclosed area is graded separately to minimize root damage.
3. When trees are located close to a proposed building or other construction activity, the fence shall be erected to allow 6 to 10 feet work space between the fence and the structure and apply organic mulch to a depth of 4 to 6 inches in the unprotected root zone area.

4. When there are street-side pedestrian walkways, fences shall be constructed in a manner that does not obstruct safe passage.

5. When there are severe space constraints due to tract size or other special requirements, the Contractor shall contact the Arborist or the Owner to discuss alternatives.

6. When any of the exceptions listed above will result in a fence being located closer than five (5) feet to a tree trunk, the Contractor shall also protect the trunk with strapped-on planking to a height of 8 feet or to the limits of lower branching in addition to the reduced fencing required.

D. Repair of Damage:

1. Tree roots scarred by equipment shall be cut cleanly and covered with topsoil.

2. When tree roots are pruned, a comparable portion of selected branches shall be cut from the tree on the opposite side.

3. Limb pruning shall be made at the branch collar. All limbs greater than 1-inch in diameter shall be precut in accordance with ANSI 300 pruning methods to prevent splitting.

4. All cut limbs shall be treated with an approved tree dressing. Tools shall be disinfected with alcohol or 5 ppm chlorine solution between repairs to trees to prevent the transmission of diseases from one tree to another.

5. All trees damaged during construction shall receive an application of fertilizer within the drip line at the rate of 4 pounds per caliper inch.

E. Cutting and Filling Around Trees:

1. When the depth of an excavation or embankment exceeds 6 inches of any tree with a diameter greater than 8 inches, a tree well shall be constructed to protect the tree.

F. Free Bore:

1. Where a pipe is to be installed within critical root zone (CRZ) and inside drip line area, installation of the pipe by free bore method is required to protect trees.

2. The length of free bore shall extend a minimum of five feet beyond drip line on both sides or as recommended length in the table provided on the Drawings, whichever is greater. The depth of free bore shall be such that there is a minimum of 4 feet of cover on top of pipe.

3. The location and procedures shall be approved by the Owner and City Arborist.

G. Paving Around Trees:

1. Where paving within the drip line of any tree greater than a 6 inch diameter is necessary, a permeable pavement and aeration system must be installed except for street construction.

H. Tree Removal:

1. Trees which directly interfere with construction may only be removed if approval of the Construction Project Manager and City Arborist has been obtained.
2. When a tree or shrub is scheduled for removal, it shall be cut to a depth of 12 inches below the surrounding ground line.
3. After removal, soil shall be placed in the hole to a depth matching the existing grade.
4. The tree shall be cut into sections that can be managed, removed from the site and disposed of.
5. All work shall be conducted in such a manner as to protect all facilities, improvements and vegetation in the work area. All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense.

I. Final Cleanup:

1. All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed.

J. Roots larger than 2-inch diameter shall not be cut without written permission from the City Arborist.

END OF SECTION 32 92 10

SECTION 32 93 00

PLANTS

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:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.

B. Related Requirements:
1. Section 32 92 00 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
2.

1.3 ALLOWANCES

A. Allowances

1. Perform planting work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications work authorized in writing by Landscape Architect.
2. Notify Landscape Architect weekly of extent of work performed that is attributable to quantity allowances.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

B. Furnish trees as part of tree allowance.

1.4 UNIT PRICES

A. Unit prices apply to authorized work covered by quantity allowances.

B. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

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

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.6 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital 3- by 5-inch format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of [three] photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
2. Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
3. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
4. Weed Control Barrier: 12 by 12 inches.
5. Proprietary Root-Ball-Stabilization Device: One unit.
6. Slow-Release, Tree-Watering Device: One unit of each size required.
7. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
8. Root Barrier: Width of panel by 12 inches.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

D. Sample Warranty: For special warranty.

1.9 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.10 QUALITY ASSURANCE

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

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Landscape Industry Certified Technician - Exterior.
b. Landscape Industry Certified Interior.
c. Landscape Industry Certified Horticultural Technician.

5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Landscape Architect, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.12 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

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

1. Spring Planting: March to May
2. Fall Planting: September to October

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.13 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization.

d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of planting completion.

a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
c. Annuals: Three months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Pine straw.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.5 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Fabric straps of length required to reach stakes or turnbuckles.
4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) Arborbrace; ArborBrace Tree Guying System.
        2) Bio-Plex, Tree Guying kits and Ties.
        3) Better Bilt Products, Inc; Tree Anchor Kit.
        4) DeepRoot Green Infrastructure, LLC; ArborTie AT LD100 Professional Anchoring Kit
        5) J. R. Partners; Tree Grate Stakes

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.
3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

        1) Border Concepts, Inc; Tomahawk Tree Stabilizers.
        2) Foresight Products, LLC; Duckbill Rootball Fixing System.
        3) Platipus Anchors, Inc. Earth Anchoring Systems
        4) Tree Staple, Inc; Tree Staples.

2.7 LANDSCAPE EDGINGS

A. Wood Edging: Of sizes indicated on Drawings, and wood stakes as follows:

1. Species: Southern pine with specified wood pressure-preservative treatment.
2. Stakes: Same species as edging, 1-by-2-inch nominal by 18 inches long, with galvanized nails for anchoring edging.

B. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Border Concepts, Inc.
    b. Colmet, Inc. (formerly Collier Metal Specialties)
    c. Russell, JD. Company (The).
    d. Sure-loc Edging Corporation.

3. Edging Size: 3/16 inch thick by 4 inches deep.
4. Stakes: Tapered steel, a minimum of 12 inches long.
5. Accessories: Standard tapered ends, corners, and splicers.
6. Finish: Manufacturer's standard paint.

    a. Paint Color: Black

C. Aluminum Edging: Standard-profile extruded-aluminum edging, ASTM B 221, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Curv-Rite, Inc.
    b. Permaloc Aluminum Edging
    c. Russell, JD Company (The).
    d. Sure-loc Edging Corporation.

3. Edging Size: 3/16 inch thick by 5-1/2 inches deep.
4. Stakes: Aluminum, ASTM B 221, Alloy 6061-T6, approximately 1-1/2 inches wide by 12 inches long.
5. Finish: Manufacturer's standard paint.

    a. Paint Color: Black.

D. Plastic Edging: Standard black polyethylene or vinyl edging, horizontally grooved, extruded in standard lengths, with 9-inch plastic stakes.

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:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. Oly-Ola Edgings, Inc.
    b. Permaloc Corporation.
    c. Sure-loc Edging Corporation.
    d. Valley View Industries.
    e. Villa Root Barrier.

3. Edging Size: 0.1 inch thick by 5 inches.
4. Top Profile: Straight, with top 2 inches being 1/4 inch thick.
5. Top Profile: Round top, 1/2 inch in diameter.
6. Accessories: Manufacturer's standard alignment clips or plugs.

2.8 TREE-WATERING DEVICES

A. Watering Pipe: PVC pipe 4 inches in diameter, site-cut to length as required, and with snug-fitting removable cap.

B. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

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. BIO-PLEX.
    b. Engineered Watering Solutions; PQ Partners, LLC.
    c. Spectrum Products, Inc.

2. Color: As selected by Landscape Architect from manufacturer's full range.

2.9 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Root Barrier: Black, molded, modular panels 24 inches high (deep), 85 mils , and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

    a. DeepRoot Green Infrastructure, LLC.
    b. NDS Inc.
    c. Villa Root Barrier.

C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

D. Burlap: Non-synthetic, biodegradable.

E. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

F. Planter Filter Fabric: Woven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

G. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by provided landscape plans or Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 9113 "Soil Preparation."

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Landscape Architect, broadcast dry product uniformly over prepared soil at application rate according to vendors recommendation.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
3. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected overnight.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions show unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Three for each caliper inch of plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Three for each caliper inch of plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Three for each caliper inch of plant.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare 2 inches (50 mm) above adjacent finish grade.

1. Backfill: Planting soil for trees, use excavated soil for backfill.
2. Spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside soil-covered roots about 1 inch from root tips; do not place tablets in bottom of the hole or touching the roots.

    a. Quantity: Three for each caliper inch of plant.

6. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. Watering Pipe: During backfilling, install watering pipe 4 feet deep into the planting pit outside the root ball with top of pipe 1 inch above the mulched surface.

H. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible fabric web ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 16 feet in height and more than 6 inches in caliper unless otherwise indicated.

1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.

    a. Securely attach guys to stakes 30 inches long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.
    b. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.

c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
d. Support trees with guy cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
e. Attach flags to each guy wire, 30 inches above finish grade.
f. Paint turnbuckles with luminescent white paint.

C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.

a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Predrill holes if necessary to prevent splitting wood.
c. Install second set of stakes on other side of root trunk for larger trees.

2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

D. Install root barrier where trees are planted within 60 inches of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

E. Align root barrier with bottom edge angled at 20 degrees away from the paving or other hardscape element and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

F. Install root barrier continuously for a distance of 60 inches in each direction from the tree trunk, for a total distance of 10 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root barrier flush with finish grade.
2. Overlap root barrier a minimum of 12 inches at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

G. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

H. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.9 GROUND COVER AND PLANT PLANTING

A. Install as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.
2. Existing Trees and Treelike Shrubs in Turf or Planting Areas: Apply 4-inch average thickness of organic mulch for 6 feet around base of tree. Do not place mulch within 6 inches of trunks or stems.
3. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.
4. Mineral Mulch in Planting Areas: Apply 2-inch average thickness of mineral mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches of trunks or stems.

3.11 EDGING INSTALLATION

A. Wood Edging: Install edging where indicated. Mitre cut joints and connections at a 45-degree angle. Fasten each cut joint or connection with two galvanized nails. Anchor with wood stakes spaced up to 36 inches apart, driven at least 1 inch below top elevation of edging. Use two galvanized nails per stake to fasten edging, of length as needed to penetrate both edging and stake and provide 1/2-inch clinch at point. Predrill stakes if needed to avoid splitting. Replace stakes that crack or split during installation process.

B. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

C. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately 36 inches apart, driven below top elevation of edging.

D. Plastic Edging: Install plastic edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 36 inches apart, driven through upper base grooves or V-lip of edging.

E. Shovel-Cut Edging: Separate mulched areas from turf areas, curbs, and paving with a 45-degree, 4- to 6-inch- deep, shovel-cut edge.

F. Mow-Strip Installation:

1. Excavate for mow strip.
2. Compact subgrade uniformly beneath mow strip.
3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
4. Install steel edging, delineating the edge of mow strip.
5. Install weed-control barrier before mulching, covering area of mow strip, and overlapping and pinning edges of barrier at least 6 inches and according to manufacturer's written instructions.
6. Place indicated thickness of organic mulch, fully covering weed barrier.
7. Rake mulch to a uniform surface level with adjacent finish grades.

3.12 TREE GRATE INSTALLATION

A. Tree Grates: Install according to manufacturer's written instructions. Set grate segments flush with adjoining surfaces. Shim from supporting substrate with soil-resistant plastic. Maintain a 3-inch- minimum growth radius around base of tree; break away portions of casting, if necessary, according to manufacturer's written instructions.

3.13 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.16 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect or municipality inspector.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 4 inches or smaller in caliper size.
2. Provide one new tree(s) of 4-inch caliper size for each tree being replaced that measures more than 6 inches in caliper size.
3. Species of Replacement Trees: Species selected by Landscape Architect.

3.17 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.18 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" section. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Twenty four months from date of Substantial Completion or issuance of Certificate of Occupancy.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Twenty four months from date of Substantial Completion or issuance of Certificate of Occupancy.

END OF SECTION 32 93 00

SECTION 32 93 43

TREE REPLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Trees
2.2	Tree Save Barrier Fence
3.1	Warranty
3.2	Workmanship

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Exploratory Excavations (02 32 19).
2. Removal of Construction Material (02 42 11)
3. Clearing and Grubbing (31 11 00)
4. Excavation and Fill (31 23 00).
5. Erosion and Sedimentation Controls (31 25 00).
6. Turf and Grasses (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.

1.3 WORK INCLUDED

A. The Contractor shall, under this item, furnish all materials, tools, labor, and equipment necessary to install select nursery trees or riverbank joint plantings for creek crossings, and install tree save barrier fence to protect designated trees, vegetation, and construction areas, to direct construction work activity away from protected areas, as indicated on the approved Drawings.

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.

B. The Contractor shall submit detailed plans for tree planting, including location and spacing, hole size, fertilizer rates, and staking requirements.

PART 2 - PRODUCTS

2.1 TREES

A. All trees shall be nursery grown.

B. Trees shall be a minimum of 2 inches in diameter as measured 12 inches above the ground. Trees shall be a minimum of 8 feet tall. The exact species of trees and river bank joint plantings must be approved by the Engineer or CUMMING UTILITIES prior to planting.

C. Refer to Contract Documents for type, size, and quantity.

2.2 TREE SAVE BARRIER FENCE

A. Materials for tree/vegetation and construction safety protection barriers shall conform to the following requirements:

1. Mesh Safety Barrier Fencing (orange color) as manufactured by Tenax, or approved equal.

2. Posts shall be a minimum length 6 feet, and made of wood or steel. Wood posts shall be 1½" x 1½" hardwood and made from Ash, Hickory, or Oak. Steel posts shall be "U", "T", or "C" shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the mesh fabric to the posts.

PART 3 - EXECUTION

3.1 PREPARATION

A. Tree Save Barrier Fencing: Install temporary tree save barrier fencing as designated on the Drawings, or where directed by the Engineer or CUMMING UTILITIES, to protect remaining vegetation from construction damage. Maintain temporary fencing and remove when construction is complete.

B. The tree save barrier fencing shall be constructed of orange color safety barrier fencing securely fastened to fence posts spaced a maximum of 5 feet on center. Posts are 6 feet in length with 2 feet set into the ground, and 4 feet extending above ground. The fencing shall be attached to the post with a minimum of four (4) nylon-locking ties, evenly placed at each post.

3.2 WARRANTY

A. All trees and riverbank plantings shall be guaranteed for a period of one (1) year after substantial completion of the project. Any trees or plantings that are dead or dying during the Warranty Period must be replaced, and at Contractor's expense.

B. Damaged temporary fencing shall be repaired or reinstalled as directed by the Engineer or CUMMING UTILITIES, and at Contractor's expense.

3.3 WORKMANSHIP

A. All trees shall be delivered with a burlap root bag, and installed with supporting wires when necessary. Riverbank planting shall be provided by an individual experienced with such plantings and their installation. Riverbank joint plantings shall be installed according to the directions of the supplier. The proposed location of trees must be marked with a stake and approved by the Engineer or CUMMING UTILITIES prior to planting.

B. All tree save barrier fencing shall be properly maintained during the construction period. Damaged temporary fencing shall be repaired or reinstalled as directed by the Engineer or CUMMING UTILITIES.

END OF SECTION 32 93 43

SECTION 33 01 30.13

SEWER AND MANHOLE TESTING

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section of the specifications provides for testing for acceptance of non-pressurized sanitary sewer installations. Upon completion of all or a part of a gravity sanitary sewer line installation, the Contractor shall test and/or inspect the sewer for acceptability. Testing and inspection shall be performed in accordance with the requirements of this section.

B. One or more of the following tests and/or inspections may be required:

1. Exfiltration of water.
2. Infiltration of water.
3. Exfiltration of air under pressure.
4. Joint testing.
5. Direct visual inspection.
6. Deflection testing.
7. Closed Circuit Television Inspection (CCTV).
8. Smoke Testing
9. Vacuum Testing

C. Prior to any testing, lines shall be backfilled, cleaned of debris and flushed clean. Debris shall be caught and removed from the line and shall not be flushed into existing live sanitary sewers. (The debris is to be disposed of properly in accordance with all laws. The Municipality can furnish a letter to the landfill stating that the contractor is authorized to dispose of the materials. Debris and liquids quantities are to be tracked in the daily contractor reports.)

1.2 RELATED SECTIONS

A. Section 31 20 00: Earth Moving

B. Section 33 31 00: Sanitary Utility Sewerage Piping

C. Section 33 39 13.13: Precast Concrete Manholes

D. Section 33 05 00: Common Work Results For Utilities

E. Section 33 39 13.16: Manhole Frames and Cover Installation

F. Section 33 33 00: Ductile Iron Pipe and Fittings

G. Section 3915: Manhole Height adjustment

1.3 REFERENCES

A. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method

B. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

C. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air

D. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill

E. Codes, Specification, and Standards

1. NASSCO – National Association of Sewer Service Companies

1.4 SUBMITTALS

A. Field Leakage Testing Plan: Submit at least 15 days in advance the testing and include at least the following:

1. Testing dates
2. Piping systems and sections to be tested
3. Test type
4. Method of isolation
5. Method of conveying water from the source to system being tested
6. Calculation of maximum allowable leakage for piping section(s) to be tested.
7. Method of disposal of test water, if applicable

B. Leakage test results

C. Pipe deflection test results

D. Pipeline lamping test results

1.5 TEST SECTIONS

A. Unless otherwise specified or directed by the Owner, each section of sanitary sewer between manholes shall be tested by the air testing method.

B. Testing shall be conducted in accordance with ASTM C924, ASTM C969, ASTM F1417, ASTM C1244, and ASTM C1244. The Owner's Engineer may allow alternate testing methods at his discretion or require additional testing methods if, in his opinion, they are warranted.

C. The Contractor may at his option divide a section of sewer into subsections of more convenient length for testing. If the section or subsection tested does not pass the tests, it shall be repaired and the test repeated until a satisfactory test is obtained.

1.6 SAFETY

A. All work shall be performed in accordance with OSHA standards and state and federal safety regulations.

B. No person shall enter a confined space without the documented requisite training, certification, entry permit, and appropriate safety and Personal Protection Equipment (PPE).

C. Refer to Section 31 20 00: Earth Moving for trench safety and protective systems.

1.7 RESPONSIBILITY FOR SANITARY SEWER OVERFLOWS AND DAMAGE TO PROPERTY AND UTILITY

A. It shall be the responsibility of the Contractor to schedule and perform the work in a manner that does not cause or contribute to incidences of sanitary sewer overflows (SSOs) as defined in the Consent Decree.

B. In the event that the Contractor's activities cause or contributes to SSOs, the Contractor shall immediately take appropriate action to immediately notify the local Municipality dispatch center and the Owner's Engineer; contain and/or stop the SSO; document the location, cause, and volume of the SSO; determine and document whether it entered a stream or storm drain (spill); clean up the spillage; and disinfect the area affected by the SSO. For details of spill response refer to the Sanitary Sewer Overflow Contingency and Emergency Response Plan (CERP). This document can be found on Department of Watershed Management website under the Consent Decree Program.

C. The Contractor shall indemnify and hold harmless the Owner for any fines or third-party claims for personal or property damage arising out of an SSO that is fully or partially the responsibility of the Contractor, including the legal, engineering, and administrative expenses of the Owner, Owner's employees, and local Municipality elected officials in defending such fines and claims.

D. Any damage to public or private property due to the work performed by the Contractor is the responsibility of the Contractor. Any damage to Owner's utilities that is caused by the Contractor's equipment or operation shall be repaired in a manner approved by the Owner's Engineer at the Contractor's expense. Any damage caused by the Contractor to utilities or property belonging to other entities shall be repaired by the Contractor to the satisfaction of the utility/property owner at the Contractor's expense. Any equipment stuck or left in the sewer line/lateral shall be retrieved by the Contractor within twenty-four (24) hours at the sole expense of the Contractor. Any damage to the Contractor's equipment is the Contractor's responsibility. If the equipment that is stuck or left in the sewer line/lateral causes a SSO, then the Contractor is liable for that SSO. The Owner reserves the right to make any repairs or retrieve any equipment and charge the Contractor accordingly.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 SANITARY SEWERS INSPECTION AND TESTING METHODS

A. Contractor to notify Owner in writing 5 days in advance of testing. Perform testing in presence of the Owner.

B. Individual joints may be tested on pipe 24 inches in diameter and larger at Contractor's option.

C. Pipe shall successfully pass leakage test prior to acceptance

D. Contractor to furnish testing equipment and perform tests as approved by the Owner. Testing equipment shall provide observable and accurate measurement of leakage under specified conditions.

E. All Testing Methods: All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, and securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable.

F. The Contractor shall backfill, clean and test lines before requesting final acceptance. Where any obstruction is met, the Contractor shall clean the sewers by means of rods, swabs, or other instruments. When requested by the Owner, the Contractor shall flush out lines and manholes before final inspection in accordance with Section 331013.41 – Cleaning of Sewers.

G. Alignment: Pipe lines shall be straight and show a uniform grade between manholes, except for curves specifically shown on the Plans or approved by the Owner. The

Contractor shall correct any discrepancies discovered during inspection at no additional cost to the Owner.

H. Watertightness: All sewers constructed shall be tested for water tightness to the maximum extent feasible. Infiltration and exfiltration tests shall be performed on all new or replacement sewers constructed as specified in this section, except for those new sewers constructed which have active services tied into them as the pipe is being installed. In such cases the water tightness of the sewers less than or equal to twenty-four (24) inches shall be based on tests as specified in sections 3.1E and 3.1F. For sewers thirty (30) inches and larger testing shall be based on the individual joint test as specified in this section. All visible leaks, including those found via television inspection, shall be repaired at no additional cost to the Owner.

I. Infiltration Tests:

1. The Contractor shall install suitable weirs in manholes selected by the Owner to determine the leakage of ground water into the sewer. The maximum length of line for each infiltration test shall be five-thousand (5,000) feet. The Contractor shall install weirs for a minimum of four (4) hours before measuring flow. If leakage in any section of the sewer line exceeds one-hundred (100) gallons per 24 hours per inch-mile of pipe, the Contractor shall locate and repair leaks. Repair methods must be approved by the Owner. After repairs are completed, the Contractor shall re-test for leakage. Infiltration testing shall be performed before sanitary sewer lateral reconnections are made.
2. The Contractor shall furnish, install, and remove the necessary weirs, plugs, and bulkheads required to perform the leakage tests.
3. Weirs shall be V-notch type by Pollard, or equivalent approved by Owner.

J. Exfiltration Tests:

1. Exfiltration Water Test:

    a. If groundwater is present and is 2 feet and above the top of the pipe for the segment being tested then an infiltration test is required.
    b. For VCP and concrete pipe fill pipe test section 24 hours prior to time of testing, if desired, to permit normal absorption into pipe walls
    c. Procedure:

        1) Maximum filling velocity shall not exceed 0.25 fps, calculated based on full area of pipe
        2) Expel air from piping system during filling.
        3) Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
        4) Maintain hydrostatic test pressure continuously for 2 hours minimum, adding additional make up water only as necessary to restore test pressure.

5) Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

d. Measurement Accuracy: Plus or minus 1/8 gallon of water leakage under specified conditions.

e. PVC and ductile iron pipe and joints shall sustain maximum water loss limit of 0.8 gallon per inch diameter per 1,000 feet of pipe, including service connections within test section per 2 hours. Allowable leakage shall be modified as stated below if hydrostatic head is other than 6 feet.

f. Clay and concrete pipe and joints shall sustain maximum water loss limit of 1.5 gallons per inch diameter per 1,000 feet of pipe, including service connections within test section per 2 hours. Allowable leakage shall be modified as stated below if hydrostatic head is other than 6 feet.

g. Hydrostatic Head:

1) At least 2 feet above maximum estimated groundwater level in section being tested, but no less than 6 feet above inside top of highest section of pipe in test section, including service connections.
2) In every case, determine height of water table at time of test by exploratory holes or such other methods approved by Engineer. Engineer will make final decision regarding test height for water in pipe section being tested.
3) If hydrostatic head is other than 6 feet, allowable leakage as computed by criteria above shall be adjusted by the square root of actual head divided by square root of 6.

h. Length of Pipe Tested: Limit length such that pressure on invert of lower end of section does not exceed 16 feet of water column. In no case shall length be greater than 700 feet or distance between manholes when greater than 700 feet.

i. Dispose of test water in a manner that will not damage or interfere with adjacent property and in a manner acceptable with Owner and regulatory agencies.

1) Low-Pressure Air Test: Sewer diameters less than or equal to twenty-four (24) inches:

j. Prior to air testing, the section of sewer between manholes shall be thoroughly cleaned and wetted. Immediately after cleaning or while the pipe is water soaked, the sewer shall be tested with low-pressure air. At the Contractor's option, sewers may be tested in lengths between manholes or in short sections (twenty-five [25] feet or less) using inflatable balls pulled

through the line from manhole to manhole. Air shall be slowly supplied to the plugged sewer section until internal air pressure reaches approximately four (4) psig. After this pressure is reached and the pressure allowed to stabilize (approximately two (2) to five (5) minutes), the pressure may be reduced to three and one-half (3.5) psi before starting the test. If a one (1) psi drop does not occur during the test time, then the line will be considered as having passed the test. If the pressure drops more than one (1) psi during the test time, the line will be presumed to have failed the test, and the Contractor shall be required to locate the failure, make necessary repairs, and retest the line at no additional cost to the Owner. Refer to ASTM C924-02 and ASTM F1417-11a for detailed testing requirements and minimum test times for various pipe sizes and types.

k. Required test equipment, including, but not limited to: inflatable balls, braces, cut-off valves, air hose, rotameter (standard CFM reading with an accuracy of ± two (2) percent), mechanical or pneumatic plugs, time measuring equipment with an accuracy of 0.1s, oil free air source with a singular control panel containing a main shut-off valve, pressure regulating valve, pressure-relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range of 0 psi to at least 10 psi with minimum divisions of 0.10 psi and an accuracy of ± two (2) percent shall be provided by the Contractor. Testing equipment shall be equal to Cherne Air-Loc Testing Systems.

l. The Contractor shall keep records of all tests made. Copies of such records shall be given to the Owner. Such records shall show date, line number and stations, operator, and such other pertinent information as required by the Owner.

m. The Contractor is cautioned to observe proper safety precautions in the performance of the air testing. It is imperative that plugs be properly installed, restrained and braced to prevent the sudden expulsion of a poorly installed or partially inflated plug. Care shall be exercised in their removal. Every precaution shall be taken to avoid the possibility of over-pressurizing the sewer line.

2. Individual Joint Test: Pipe joints for sewers greater than (24) inches in diameter shall be air tested individually as specified in paragraph 3.2 Joint Testing Procedures.

K. Smoke Testing: Smoke testing may be used only to locate leaks and in no case shall be considered conclusive or a substitute for air tests, exfiltration tests, or infiltration tests. In all cases a smoke test shall be accompanied by an air test, exfiltration test, or infiltration test. The Owner may order a smoke test if another leakage test fails and the source of the leak cannot be determined by other means. Smoke testing may only be performed where ground water is low. Smoke shall be blown into a sealed section of sewer under pressure and the Contractor and Owner shall observe for any smoke appearing on top of the ground indicating the presence of leaks. The Owner may require that the Contractor excavate the sewer to determine the source of any smoke appearing during the smoke test. All

leaks or breaks discovered by the smoke tests shall be repaired and/or corrected by the Contractor at his own expense in a manner acceptable to the Owner. Equipment and supplies required for smoke tests shall be furnished by the Contractor. The Contractor may perform smoke tests at any time during construction at his option; however, any such tests shall not supplant the final test of the completed work.

L. Deflection Test: All PVC gravity sewers:

1. The Contractor shall test PVC gravity sewers for excessive deflection by passing a mandrel through the pipe. Deflection of the pipe shall not exceed five (5) percent. The mandrel size shall be based upon the maximum possible inside diameter for the type of pipe being tested, taking into account the allowable manufacturing tolerances of the pipe. The mandrel shall be configured as shown on the Plans or directed by the Owner and shall have an odd number of legs, or vanes, with a quantity equal to or greater than nine (9). The legs of the mandrel shall be permanently attached to the mandrel. A mandrel with variable sizes shall not be allowed. The mandrel shall be constructed of steel, aluminum, or other material approved by the Owner, and shall have sufficient rigidity so that the legs of the mandrel will not deform when pulling through a pipe. The Contractor shall provide a proving ring for each size mandrel, with a tolerance of no more than 0.02 inch clearance, and the mandrel dimensions shall be checked by the Owner using this proving ring, before use by the Contractor.
2. The Contractor shall excavate and install properly any section of pipe not passing this test and re-test until results are satisfactory at no additional cost to the Owner.
3. This test shall be performed twice:

    a. Once within the first thirty (30) days of installation, and
    b. Once during final inspection, but no sooner than thirty (30) days after pavement backfill is done.

M. Closed Circuit Television Inspection: The Owner's Engineer may require that the interior of a new gravity sewer be subjected to television inspection. CCTV Inspections shall be in accordance with National Association of Sanitary Sewer Companies Specification Guidelines. Prior to final acceptance the Owner shall be provided with one copy of the TV inspection report and CD-ROMs showing the entire length of the gravity sewer tested. The report shall contain the condition of pipe, type of pipe, depth, location of services, length, type of joints, roundness, and distance between manholes. Any pipe found to be cracked, leaking, misaligned, bellied, or otherwise defective shall be removed and replaced at no additional cost to the Owner.

N. Direct/Manual Visual Inspection: The inspection of new pipe 36 inches in diameter and larger may be manually inspected. The contractor shall provide any specialized equipment for inspection for the Owner. Voice communication between in-pipe and aboveground personnel will be maintained at all times during the inspection. Record inspection in format required by the owner and provide inspection logs. Provide digital, color, still photographs of defects or other features as requested by the Owner. Log sheets

to include but not limited to: time and date of inspection, location, upstream and downstream structure numbers, pipeline length, pipe size, pipe segment length, pipe material, lateral connection located by pipe segment number, and location and detail of defects encountered.

3.2 JOINT TESTING PROCEDURES

A. Joint Testing Procedures: Each sanitary sewer joint shall be individually air tested using a packer or other approved testing device at the following test pressure:

1. Joint test pressure shall be 3-psi higher than the groundwater pressure, if any, outside the pipe. Groundwater pressure may be determined by positioning the testing device on a visibly infiltrating joint and measuring the resulting VOID pressure with the VOID pressure monitoring equipment.
2. In the absence of groundwater pressure data, the test pressure shall be equal to 1/2 psi per vertical foot of pipe depth or 3 psi, whichever is greater.
3. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested. The testing device end elements (sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a VOID area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient inflation pressure to contain the air within the VOID without leakage past the expanded ends. Air shall then be introduced into the VOID area until a pressure equal to or greater than the required test pressure is observed with the VOID pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test. After the VOID pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the VOID pressure decays by more than 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test.
4. All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation by the Owner’s Engineer. The void pressure data shall be transmitted electronically from the void to the monitoring equipment.
5. Prior to starting the sanitary sewer joint testing, a two (2) part control test shall be performed as follows:

    a. To insure the accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test will be performed in a test cylinder constructed in such a manner that a minimum of three (3) known leak sizes can be simulated (0.062, 0.094, 0.125 inch diameter). This technique will establish the test equipment performance capability in relationship to the test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall be instructed to repair or otherwise modify his equipment and re-perform the test until the

results are satisfactory to the Owner. This test may be required at any other time during the joint testing work if the Owner suspects the testing equipment is not functioning properly. The demonstration test may be required, by the Owner, at any other time during the joint testing work at no additional cost to the Owner.

b. After entering each manhole section with the test equipment, but prior to the commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure will demonstrate the reality of the test requirement, as no joint will test in excess of the pipe capability. Should it be found that the barrel of the sewer pipe will not meet the joint test requirements, the requirements will be modified as necessary.

6. During the sanitary sewer joint testing work, the Contractor shall keep the following records:

a. Identification of the manhole to manhole section tested.
b. Test pressure used.
c. Location (footage) of each joint tested.
d. Test results for each joint tested.

B. Lamping Procedures: Lamping will be performed on all sewer pipelines by the Owner. When lamping is to be performed by the Owner, the Contractor shall provide access to the sewer and facilitate the Owner in execution, as needed.

3.3 MANHOLE TESTING METHODS

A. All manhole inserts, new manholes, and replacement manholes shall be tested by the Contractor using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after installation of inserts. Any leakage in the manhole or structure, before, during, or after the test shall be repaired at no additional cost to the Owner.

B. Manholes:

1. Prior to testing manholes for water tightness, all lift holes shall be plugged with a non-shrink grout, all joints between precast sections shall be properly sealed and all pipe openings shall be temporarily plugged and properly braced.
2. Vacuum Tests shall be performed in accordance with ASTM C1244: If the manhole fails the initial test, necessary repairs shall be made with non-shrink grout. Retesting shall proceed until a satisfactory test is obtained. Vacuum testing equipment shall be equal to that as manufactured by P.A. Glazier, Inc., or approved equal.

C. The Owner reserves the right to have third party consultants perform construction materials testing and assessments to any new manhole.

D. The use of soapy water on the manhole walls to help determine the areas of leakage is permitted.

END OF SECTION 33 01 30.13

SECTION 33 05 00 COMMON

WORK RESULTS FOR

UTILITIES

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. This Section includes the following:

1. Piping joining materials.
2. Transition fittings.
3. Dielectric fittings.
4. Sleeves.
5. Identification devices.
6. Grout.
7. Flowable fill.
8. Piped utility demolition.
9. Piping system common requirements.
10. Equipment installation common requirements.
11. Painting.
12. Concrete bases.
13. Metal supports and anchorages.

1.3 DEFINITIONS

A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.

B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. CPVC: Chlorinated polyvinyl chloride plastic.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Dielectric fittings.
2. Identification devices.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.8 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness, unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

4. PVC to ABS Piping Transition: ASTM D 3138.

H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 TRANSITION FITTINGS

A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings NPS 1-1/2 and Smaller:

1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
2. Aboveground Piping: Specified piping system fitting.

C. AWWA Transition Couplings NPS 2 and Larger:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cascade Waterworks Mfg. Co.
b. Dresser, Inc.; DMD Div.
c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
d. JCM Industries.
e. Smith-Blair, Inc.
f. Viking Johnson.

3. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

D. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Spears Manufacturing Co.

3. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Colonial Engineering, Inc.
   b. NIBCO INC.
   c. Spears Manufacturing Co.

3. Description: MSS SP-107, PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cascade Waterworks Mfg. Co.
   b. Fernco, Inc.
   c. Mission Rubber Company.
   d. Plastic Oddities.

3. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.3 DIELECTRIC FITTINGS

A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Epco Sales, Inc.
   d. Hart Industries, International, Inc.
   e. Watts Water Technologies, Inc.
   f. Zurn Plumbing Products Group; Wilkins Div.

3. Description: Factory fabricated, union, NPS 2 and smaller.

a. Pressure Rating: **150 psig** at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Water Technologies, Inc.

3. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 and larger.

a. Pressure Rating: **150 psig**.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

3. Description: Nonconducting materials for field assembly of companion flanges, NPS 2-1/2 and larger.

a. Pressure Rating: **150 psig**.
b. Gasket: Neoprene or phenolic.
c. Bolt Sleeves: Phenolic or polyethylene.
d. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Calpico, Inc.
b. Lochinvar Corporation.

3. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, NPS 3 and smaller.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Threaded.

F. Dielectric Nipples:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Perfection Corporation.
b. Precision Plumbing Products, Inc.
c. Victaulic Company.

3. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.

a. Pressure Rating: **300 psig at 225 deg F.**
b. End Connections: Threaded or grooved.

2.4 SLEEVES

A. Mechanical sleeve seals for pipe penetrations are specified in Section 22400: Plumbing

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.

D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.

F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.5 IDENTIFICATION DEVICES

A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Owner’s option.

B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
2. Location: Accessible and visible.

C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is 1-1/4 inches for ducts, and 3/4 inch for access door signs and similar operational instructions.

1. Material: **Brass**.
2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.

F. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers, extending 360 degrees around pipe at each location.

G. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.

H. Lettering: Manufacturer's standard preprinted captions as selected by Architect.

I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.

1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.

J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils thick.

1. Width: 1-1/2 inches on pipes with OD, including insulation, less than 6 inches; 2-1/2 inches for larger pipes.
2. Color: Comply with ASME A13.1, unless otherwise indicated.

K. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick, **polished brass**
2. Material: 0.0375-inch- thick stainless steel.
3. Material: 3/32-inch- thick plastic laminate with 2 black surfaces and a white inner layer.
4. Material: Valve manufacturer's standard solid plastic.
5. Size: 1-1/2 inches in diameter, unless otherwise indicated.
6. Shape: As indicated for each piping system.

L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.

M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
2. Thickness: **1/16 inch, 1/8 inch**, unless otherwise indicated.
3. Thickness: 1/16 inch, for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.

N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Brown: Energy reclamation equipment and components.

4. Blue: Equipment and components that do not meet criteria above.
5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
6. Terminology: Match schedules as closely as possible. Include the following:

    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

7. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.

1. Size: 3-1/4 by 5-5/8 inches.
2. Fasteners: Brass grommets and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.

1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.7 FLOWABLE FILL

A. Description: Low-strength-concrete, flowable-slurry mix.

1. Cement: ASTM C 150, Type I, portland.
2. Density: **115- to 145-lb/cu. ft.**.
3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.

4. Aggregates: ASTM C 33, natural sand, fine.
5. Admixture: ASTM C 618, fly-ash mineral.
6. Water: Comply with ASTM C 94/C 94M.
7. Strength: **100 to 200 psi** at 28 days.

PART 3 - EXECUTION

3.1 PIPED UTILITY DEMOLITION

A. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 DIELECTRIC FITTING APPLICATIONS

A. Dry Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric unions.
2. NPS 2-1/2 to NPS 12: Dielectric flanges **or dielectric flange kits**.

B. Wet Piping Systems: Connect piping of dissimilar metals with the following:

1. NPS 2 and Smaller: Dielectric **couplings or dielectric nipples**
2. NPS 2-1/2 to NPS 4: Dielectric nipples.
3. NPS 2-1/2 to NPS 8: Dielectric nipples or dielectric flange kits.
4. NPS 10 and NPS 12: Dielectric flange kits.

3.3 PIPING INSTALLATION

A. Install piping according to the following requirements and utilities Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping to permit valve servicing.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Sleeves are not required for core-drilled holes.

J. Permanent sleeves are not required for holes formed by removable PE sleeves.

K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas **2 inches** above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

    a. **Steel** Pipe Sleeves: For pipes smaller than NPS 6.
    b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

L. Verify final equipment locations for roughing-in.

M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.

K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
5. PVC Nonpressure Piping: Join according to ASTM D 2855.
6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End PE Pipe and Fittings: Use butt fusion.
2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.

O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install dielectric fittings at connections of dissimilar metal pipes.

3.6 EQUIPMENT INSTALLATION

A. Install equipment level and plumb, unless otherwise indicated.

B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.

C. Install equipment to allow right of way to piping systems installed at required slope.

3.7 PAINTING

A. Painting of piped utility systems, equipment, and components is specified in Section 099113: “Painting and Coating”

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 IDENTIFICATION

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: According to ASME A13.1.
2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
3. Locate pipe markers on exposed piping according to the following:

    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    d. At manholes and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.

B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.

1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Section 05 50 00 "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.11 GROUTING

A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION 33 05 00

SECTION 33 05 13

MANHOLE FRAMES AND COVERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal as shown on the drawings and specified herein.

1.2 COORDINATION

A. The work of this Section shall be completely coordinated with the work of other sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this section before fabrication and installation of items herein specified.

B. Furnish to the pertinent trades all items included under this section that are to be built into the work of other sections.

1.3 SHOP DRAWINGS

Detail drawings, as provided showing sizes of members, method of assembly, anchorage, and connection to other members shall be submitted for approval before fabrication.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken at the site to verify or supplement indicated dimensions and to insure proper fitting of all items.

PART 2 - PRODUCTS

2.1 FABRICATED ITEMS

A. Manhole Frames and Covers:

1. Manhole frames and cover castings shall be good quality, strong, tough, even-grained, cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and subject to hammer inspection. Manhole covers and frame seats shall be machined true to a plane surface. Before shipment from the factory, casting shall be given one cast of coal tar pitch varnish which shall present a coating which is smooth and tough, but not brittle. Sizes shall be as shown on the drawings. Cast iron shall be grey iron casting conforming to the AASHTO Designation M-105 and shall be Class No. 30.
2. Frames and covers shall have a minimum total weight of 460 pounds. Covers shall have a weight not less than 150 pounds.
3. Frames and covers shall be of the "Type W" unless noted otherwise on the drawings. All covers shall have the words "STORM SEWER" in raised 2 inch letters cast into the top. Type "W" shall be the waterproof frame and cover with bolted lid, 1/8 inch neoprene gasket and sufficient counter sunk hexagonal-head cap screws cover to frame to produce a waterproof seal.
4. All manhole frames and covers shall have a minimum of 22 inches clear opening between the innermost ring. The lower flange of the frame shall be at least 6 to 8 inches. The lower flange of the frame shall be at least 6 inches in width. All covers shall be supplied with two concealed watertight pick holes.

B. Manhole Steps:

1. Manhole steps shall be Clow Corporation F-3650 or approved equal.

PART 3 - EXECUTION

3.1 FABRICATION

All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability.

3.2 INSTALLATION

A. Install all items furnished except items to be imbedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in

masonry will not be permitted. All dimensions shall be verified at the site before fabrication is started.

B. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bituminous troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

END OF SECTION 33 05 13

SECTION 33 05 23.16

UTILITY PIPE JACKING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Overview
1.4	Work Included
1.5	Qualifications
1.6	Submittals
2.1	Materials
3.1	General
3.2	Maintaining Traffic and Public Safety
3.3	Steel Casing – Jack and Bore
3.4	Steel Casing - Open Cut Installation
3.5	Uncased Boring/Free Bore

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Exploratory Excavations (02 32 19).
2. Cast-in-Place Concrete (03 30 00).
3. Brick Masonry (04 21 13).
4. Excavation and Fill (31 23 00).
5. Erosion and Sedimentation Controls (31 25 00).
6. Turf and Grasses (32 92 00).
7. Traffic Control (34 41 16.10).

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.

1.3 OVERVIEW

A. The Contractor shall be held fully responsible for protecting against surface subsidence, damage, or disturbance to adjacent property and facilities from Contractor's construction methods. In case loose material is encountered and cave-ins occur or are anticipated, all jacking/auguring shall be discontinued, shoring shall be provided and all voids filled or pressure grouted. Supplemental measures and alternative methods must

receive approval of the Engineer before jacking/augering operation recommences. Any settlement or upheaval of the existing roadway pavements during the jacking and boring operation, and throughout the warranty period, shall be repaired/restored at the Contractor's expense.

B. Following completion of the jacking operations, the carrier pipe shall be inserted within the casing; its invert placed upon approved skids or casing insulators (for mains with diameters of 6-inches or greater), previously set on inner-base of the casing. The ends of the casing shall be sealed with brick bulkheads using brick and mortar meeting requirements of Section 04 21 13 BRICK MASONRY, and as indicated on the Drawings.

C. All jacking/auguring operations must be performed in compliance with the rules and regulations of the Forsyth County Department of Transportation (FCDOT), State of Georgia Department of Transportation, or other authorities having jurisdiction.

D. All sheeting placed for the jacking/auguring operation must be completely removed by the Contractor prior to backfill.

1.4 WORK INCLUDED

A. The Contractor shall under this item**,** furnish all material, labor, tools, and equipment necessary for the complete installation of an uncased boring, jacked steel casing, free bore, or installation of steel casing by open-cut method, as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

B. The Work shall include, but is not limited to: bore pit excavation, sheeting, shoring, plating, and installing safety barriers for the protection of workers, vehicular and pedestrian traffic, and the general public; steel pipe casing, skids, excavation, rock excavation, backfill, restoration of site, grout, brickwork, earth augers, jacking machine, welder, and other accessories necessary for a complete installation as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

C. When the bore pit excavation and/or the jacking/augering operation occurs along existing right-of-way, care must be taken to ensure all Work is performed within the right-of-way, or arrangements must be made with the owner of the affected property to permit any encroachment onto the affected property.

1.5 QUALIFICATIONS

A. Utility pipe jacking operations shall be performed by a qualified contractor who has constructed at least five (5) similar installations, which were constructed within one (1) year of each other, and have been in continuous successful operation for not less than five (5) years.

1.6 SUBMITTALS

A. Submit to the Engineer, per the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, evidence of Utility Pipe Jacking experience as specified in paragraph 1.5.A. of this specification.

B. The Contractor shall submit for approval to the Engineer, CUMMING UTILTIES, FCDOT, (and Georgia DOT when work is within a state road right-of-way), all working drawings and schedules of procedure proposed to be followed in the prosecution of the Work under this item.

C. Working drawings shall show in detail, the size and location of jacking pits together with all sheeting and shoring to be used in supporting embankments, trench walls, and all other structural details together with large scale plan and profile of the proposed jacked installation and affected structures.

D. Schedules shall set forth the sequence of the various operations together with the time the Contractor proposes to begin and complete the several phases of the Work.

E. Contractor shall not proceed with the Work until final approval has been given by the Engineer, CUMMIING UTILTIES, FCDOT, and/or GDOT.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subject to compliance with requirements, provide products of smooth wall steel pipe.

B. For steel casing pipe up to twenty inch (20”) diameter, wall thickness shall be a minimum of 0.375 (3/8) inch, with the pipe having sufficient strength to withstand superimposed loads and jacking stresses. For steel casing pipe twenty-four inch (24”) and greater, wall thickness shall be a minimum of 0.500 (1/2) inch.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise specified, the ends of casings shall be sealed with brick bulkheads using brick and mortar.

3.2 MAINTAINING TRAFFIC AND PUBLIC SAFETY

A. All working operations of the Contractor, their subcontractor(s), and/or their agents or employees, must be subordinated to the free and unobstructed use of the roadway, and structures encountered in the execution of jacking and boring operations.

B. The Contractor shall proceed with the Work in such a manner as will permit: regular transaction of business by commercial operations adjacent to the project site, without delay or danger to persons or property; free access to and from private residences; and will allow the safe flow of traffic and pedestrians around the work site. The Contractor shall employ the use of traffic control devices as necessary, as specified in Section 34 41 16.10 TRAFFIC CONTROL. The Contractor shall suspend all operations relating to jacking and boring until necessary safety precautions have been met.

C. Schedules shall set forth the sequence of the various operations, together with the time proposed to begin and complete the phases of the Work.

3.3 STEEL CASING – JACK AND BORE

A. The Contractor shall jack a steel casing pipe as indicated on the Drawings, using a special earth auger machine. The casing shall be jacked to the line and grade indicated on the Drawings.

B. Each joint of casing shall be **fully** welded around its entire circumference to the adjacent joint prior to being jacked.

C. All steel casing buried underground or submerged shall have a standard bituminous outside coating conforming to AWWA Standard Specifications.

D. Following completion of the jacking operations, the carrier pipe shall be inserted within the casing and its invert supported by pre-fabricated casing spacers. The ends of the casing shall be sealed with brick bulkheads using brick and mortar.

3.4 STEEL CASING - OPEN CUT INSTALLATION

A. Where indicated on the Drawings, or permitted or directed by the Engineer or CUMMING UTILITIES, the Contractor shall place the steel casing directly in an open ditch for subsequent installation of a carrier pipe after backfill. Except for the method of installation, all requirements of this item shall apply. Ditch preparation, backfill, and compaction shall be as required for direct–bury ductile iron pipe.

3.5 UNCASED BORING / FREE BORE

A. When indicated on the Drawings, or permitted or directed by the Engineer or CUMMING UTILITIES**,** the Contractor shall use a special earth auger machine to bore a controlled hole to the line and grade, as indicated on the Drawings. Said hole shall be of a constant diameter, which shall not exceed four (4) inches larger than the bell diameter of the proposed carrier pipe, and shall be maintained until the pipe is installed through the hole. If the annular space between the earthen hole and the carrier pipe exceeds six (6) inches, then the Contractor shall fill such space by pressure grouting or pumping in a flowable fill to eliminate possible settlement.

B. At no time will free bores in excess of forty feet (40’) be permitted.

END OF SECTION 33 05 23.16

SECTION 33 10 00

WATER UTILTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related work specified elsewhere includes:

1. Section 31 20 00 - “Earth Moving”
2. Division 22 – “Plumbing”

1.2 SUMMARY:

A. This Section includes water service piping system, meter, vaults, valves, and appurtenances from the existing on-site utility source of potable water to a point 5 feet outside the building, and as indicated on the Drawings, and in this Section of the Project Manual.

B. Note that the Contractor shall furnish and install connection, water meter, etc., acceptable to the utility company and call on the utility company to approve the meter and inspect the installation prior to covering.

C. All fees and charges for water service, meters, taps, permits, impact fees, etc., if any, shall be paid by the Contractor from their contract amount.

D. The extent of water service piping system, fire hydrants, etc., is indicated on the Drawings, in this Section, other referenced Sections of the Project Manual, and as otherwise required by authorities having jurisdiction.

1. All water pipe which run under roads, streets, driveways, and other vehicular paving shall be sleeved in AWWA C151 ductile iron sleeves.

E. Utility Compliance: Comply with CUMMING UTILITIES regulations and standards pertaining to sanitary sewerage systems.

1. Where conflicts or discrepancies occur with the plans or these specifications, CUMMING UTILITIES regulations and standards shall govern.

1.3 SUBMITTALS:

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections

1. Product data for water service piping and fire protection pipe and specialties.
2. Shop drawings for vaults, junction boxes, valve boxes, manholes, meters, backflow preventers, and other similar water service equipment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS - GENERAL:

A. General: Pipe, valves, fittings and installation in R.O.W. and on site shall comply with requirements of this Section, other referenced Sections of the Project Manual, the Drawings, and CUMMING UTILITIES.

1. Pipe, fittings, hydrants and valves shall be as specified herein, subject to acceptance by CUMMING UTILITIES, unless other specific materials acceptable to CUMMING UTILITIES are indicated on the Drawings.

2. PVC piping and fittings smaller than 4” shall be C900 PVC, Class 200 plastic pipe, Schedule 40, or Type K Copper; and pipe 4” and larger, below paving and fire lines shall be ductile iron, of type(s) acceptable to the CUMMING UTILITIES, unless other specific materials acceptable to the CUMMING UTILITIES are indicated on the Drawings.

3. PVC water piping and fittings 4” and larger shall be C900, Class 250 plastic pipe of type acceptable to local utility company, unless other specific materials acceptable to utility company are indicated on the Drawings.

4. Ductile iron pipe for fire lines, pipe below paving and where indicated shall meet ANSI A21.51, Grade 60-42-10, and special thickness pressure class 50, (For 6” Pipe this is the same 0.25” wall thickness as Class 350) ductile iron, of type(s) acceptable to local utility company, unless other specific materials acceptable to utility company are indicated on the Drawings.

5. Note that all water pipe which run under roads, streets, driveways, and other vehicular paving shall be either ductile iron or shall be sleeved in ductile iron sleeves.

6. Copper pipe where indicated, provide Soft Copper Tube, ASTM B 88-62, Type K hard drawn, water tube, annealed temper.

a. Copper, Solder-Joint Fittings: AWWA C800-6 and 66. Corp stops shall be ¾" Ford F-1000 CC x COMP or equal, curb stops shall be ¾" Ford B-41-233W COMP x FIP or equal, and service saddles shall be dresser style 194 or equal. Furnish only wrought-copper fittings if indicated.

B. PVC Plastic, Schedule 40/80 PVC with pressure-rated fittings: Conform to ASTM D 1785 standard specifications for PVC plastic pipe.

C. PVC Plastic, Water Pipe: AWWA C900, Class 200. Include elastomeric seal according to ASTM F477.

D. Ductile Iron Fittings: AWWA C110, ductile-iron; or AWWA C153, ductile-iron, compact type, and specifically designed for joining PVC pipe; Include elastomeric seals according to ASTM F 477 or as otherwise required for joining plastic pipe specified

E. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended in writing by piping system manufacturer, unless otherwise indicated.

F. Where copper pipe is indicated, provide Soft Copper Tube, ASTM B 88, Type K, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

E. Ductile-Iron, Push-on-Joint Pipe: AWWA C151 and ANSI C150, C151, A21.50, and A21.15 respectively, Class 350 as approved by t CUMMING UTILITIES, tar coated outside, with cement lining and seal coat according to AWWA C104. Include rubber compression gasket according to AWWA C111.

1. Ductile-Iron, Push-on-Joint Fittings: AWWA C110, ductile-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and rubber compression gaskets according to AWWA C111 (ANSI 21.11) and according to ASTM D-3139.

2. Joining Materials: AWWA C111 rubber gaskets and lubricant according to ASTM F477 requirements.

F. Ductile-Iron, Mechanical-Joint Pipe: AWWA C151, with cement-mortar lining and seal coat according to AWWA C104. Include gland, rubber gasket, and bolts and nuts according to AWWA C111.

1. Ductile-Iron, Mechanical-Joint Fittings: AWWA C110, ductile-iron; or AWWA C153, ductile-iron, compact type. Include cement-mortar lining and seal coat according to AWWA C104 and glands, rubber gaskets, and bolts and nuts according to AWWA C111.

2. Joining Materials: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.

G. PE Encasement for Ductile-Iron Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch (0.20-mm) minimum thickness, tube or sheet.

H. Pipe Sleeves: Provide pipe sleeves at least one size larger than water service piping required below existing concrete and paving, and as follows.

1. Below Concrete, Entry Pads, and Paving Subject to Only Pedestrian Traffic, and for Future Irrigation: Schedule 40/80 PVC.

2. Below Concrete, Equipment Pads, Dumpster Pads, Valley Gutters, Curbs and Gutters, Paving Subject to Vehicular Traffic, and Where Indicated: Ductile Iron, as specified above herein this Section.

I. Identification for Underground Plastic Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allen Systems, Inc.; Reef Industries, Inc.
b. Brady (W.H.) Co.; Signmark Div.
c. Calpico, Inc.
d. Carlton Industries, Inc.
e. EMED Co., Inc.
f. Seton Name Plate Co.

2. Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in blue letters “CAUTION - WATER LINE BURIED BELOW.”

K. Domestic Water Meter – Provide in accordance with CUMMING UTILITIES specifications.

1. Meter box and cover shall be traffic-bearing in all paved areas.

L. Tapping Sleeve and Valve:

1. Tapping sleeves and valves shall be Mueller, mechanical joint, 250 psi or equal.
2. Tapping sleeves shall have 24”x24”x8” concrete pad in undisturbed soil with solid blocking to support tapping valves.

M. Valves:

1. Unless otherwise specified, all gate valves up to 12” shall be resilient seat, and all gate valves larger than 12” shall be butterfly type. All valves larger than 12” shall receive approval from the City before installation.
2. Acceptable manufacturers of gate valves are American-Darling, Dresser M&H, or equal.

N. Valve Accessories:

1. All buried valves shall be furnished with cast iron, screw type; extendable valve boxes marked “WATER”. Acceptable manufacturers are Mueller, M&H Valve, or equal.
2. Valve boxes shall be mounted plumb in an 18” round concrete valve pad and centered over the operating nut.
3. One concrete valve marker shall be furnished and set at each line valve. The marker shall be made of 3,000 psi concrete with four #4 reinforcing bars. The size shall be four feet long by 4” on each side.

O. Hydrants

1. Fire Hydrants shall meet AWWA C-502-80 as well as the local authorities having jurisdiction.

2. Hydrants shall be manufactured by Mueller or an approved equal.

3. Hydrants shall be equipped with tamper proof caps that will work with City operating wrenches to prevent unauthorized use of water.

4. Hydrants shall be warranted by the manufacturer against defects in materials or workmanship for at least 10 years from the date of manufacture.

PART 3 - EXECUTION:

3.1 INSTALLATION:

A. Comply with requirements of Division 22, the International Plumbing Code, Drawings, CUMMING UTILITIES and requirements of other authorities having jurisdiction.

B. Comply with requirements of the State Health Department, the local Health Department, and authorities having jurisdiction.

3.2 DEPTH OF COVER:

A. Provide minimum cover of 36-inches for all water bearing piping.

3.3 INSTALLATION OF IDENTIFICATION:

A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.4 CLEANING:

A. Clean and disinfect water distribution piping as follows, or as required by utility company, Code, and authorities having jurisdiction:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, use the procedure described in AWWA C651, or as described below:

a. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.

b. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.

c. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.

d. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities and submit for review and along with each set of “Record Documents”.

END OF SECTION 33 10 00

SECTION 33 11 15

VALVES AND APPURTENANCES FOR SITE UTILITIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals and install complete and ready for operation all valves and appurtenances as shown on the drawings and as specified herein.

B. The equipment shall include, but not be limited to, the following:
   1. Gate valves
   2. Post indicator

1.2 RELATED WORK

A. Section 31 20 00: Earth Moving

B. Sections 31 50 00: Excavation Support and Protection.

1.3 QUALIFICATION

A. All of the types of valves and appurtenances shall be the products of firms fully experienced and qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

1.4 SUBMITTALS

A. Submit within thirty (30) days after execution of the contract a list of materials to be furnished, the names of the suppliers and the date of delivery of materials to the site.

B. Complete shop drawings of all valves and appurtenances shall be submitted for review.

1.5 TOOLS

A. Special tools, if required for normal operation and maintenance shall be supplied with the equipment.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. General:

1. All valves and appurtenances shall be of the same size shown on the drawings and as far as possible all equipment of the same type shall be from one manufacturer.
2. All valves and appurtenances shall have the name of the maker and the working pressure for which they are designed cast in raised letters upon some appropriate part of the body.

B. Gate Valves and Appurtenances:

1. Gate valves for water shall meet the requirements of AWWA C509. Valve shall be rated for 150 psi working pressure and a minimum 300 psi test pressure. Valves shall be iron body, bronze-mounted, double disc, parallel seat, non-rising stem type fitted with "O-Ring" seals. The operating nuts shall be 2" square. All valves shall open left, or counterclockwise. Stuffing boxed shall be the "O-Ring" type. Gate valves shall be mechanical joint, ANSI Standard 21.11 except where shown otherwise. Flange joint shall be ANSI B16.1 standard. Bell joint shall be AWWA Class 150.
2. All buried valves shall have cast iron three piece valve boxes. Valve boxes shall be provided with suitable heavy bonnets and to extend to such elevation at or slightly above the finished grade. The barrel shall be two-piece, sliding type, having 5-1/4" shaft. The upper section shall have a flange at the bottom having sufficient bearing area to prevent settling.

C. Where shown on the drawings Post Indicators for the gate valves shall be M & H Floor Stand Style, as manufactured by Clow Coperation, Eddy-Iowa Division or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All valves and appurtenances shall be installed in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired before they are installed.

B. After insulation, all valves and appurtenances shall be tested at least 1 hour at the working pressure corresponding the class of pipe, unless a different test pressure is specified. If any joint proves to be defective, it shall be repaired.

C. Buried flanged or mechanical joints shall be made with cadmium plated bolts. All exposed bolts shall be made with cadmium plated bolts. All exposed bolts and nuts shall be heavily coated with two (2) coats of bituminous paint comparable to Inertol No. 66 Special Heavy.

D. Prior to assembly of split couplings, the grooves as well as other parts shall be thoroughly cleaned. The ends of the pipes and outside of the gaskets shall be moderately coated with petroleum jelly, cup grease, soft soap or graphite paste, and the gasket shall be slipped over one pipe end. After the other pipe has been brought to the correct position, the gasket shall be centered properly over the pipe ends with the lips against the pipes. The housing sections then shall be placed. After the bolts have been inserted, the nuts shall be tightened until the housing sections are firmly in contact, metal-to-metal, without excessive bolt tension.

E. Prior to the installation of sleeve-type couplings, the pipe ends shall be cleaned thoroughly for a distance of 8". Soapy water may be used as a gasket lubricant. A follower and gasket, in that order, shall be slipped over each pipe to a distance of about 6" from the end, and the middle ring shall be placed on the already laid pipe end until it is properly centered over the joint. The other pipe end shall be inserted into the middle ring and brought to proper position in relation to the pipe already laid. The gaskets and followers shall then be pressed evenly and firmly into the middle ring flares. After the bolts have been inserted and all nuts have been made up finger tight, diametrically opposite nuts shall be progressively and uniformly tightened all around the joint, preferable by use of a torque wrench of the appropriate size and torque for the bolts.

F. Castings shall be of good quality, strong, tough, even grained, smooth, free from scale, lumps, blisters, sand holes, and defects of any kind which render them unfit for the service for which they are intended. Castings shall be thoroughly cleaned and will be subjected to a hammer inspection in the field. All finished surfaces shown on the drawings and/or specified shall be machined to a true plane surface and shall be true and seat at all points without rocking. Allowances shall be made in the patterns so that the thickness specified or shown shall not be reduced in obtaining finished surfaces. Castings will not be acceptable if the actual weight is less than 95% of the theoretical weight computed from the dimensions shown. Provide facilities for weighing castings showing true weights, certified by the supplier.

G. All steel surfaces to come in contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bituminous trowelling mastic applied in accordance with the manufacturer's instructions prior to installation.

3.2 SHOP PAINTING

A. Paint used for coating valves shall comply with the following Fed. Spec. TT-V-51, TT-C-494a, AWWA C-550. The asphalt varnish shall be applied to the ferrous parts of the valves except for finished or seating surfaces. Surfaces shall be clean and dry before painting. Two coats shall be applied to both the inside and outside ferrous metals. A coating conforming to AWWA C-550 may be used on the interior and/or exterior ferrous surfaces.

3.3 INSPECTION AND TESTING

A. Completed pipe shall be subjected to hydrostatic pressure test for 12 hours at full working pressure. All leaks shall be repaired and lines re-tested. Prior to testing, the gravity pipelines shall be supported in an approved manner to prevent movement during tests.

END OF SECTION 33 11 15

SECTION 33 12 16

WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
1.3	Quality Assurance
1.4	Delivery, Storage, and Handling
1.5	Warranty
2.1	General
2.2	Gate Valves
2.3	Ball Valves
2.4	Electric Actuated Butterfly Valves
2.5	Air Release Valves
2.6	Extension Stems
2.7	Floor Stands
2.8	Valve Boxes
2.9	Manual Valve Operators
2.10	Painting
2.11	Shop Testing
3.1	Installation
3.2	Shop and Field Testing
3.3	Valve Schedule

B. Scope

1. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation all water valves and valve appurtenances as shown on the Drawings and/or specified herein.

1.2 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data

a. Product data sheets for each make and model. Indicate valve type number, applicable tag number, and facility name/number or service where used.

b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

c. For each power actuator provided, manufacturer's standard data sheet, with application specific features and options clearly identified.

d. Sizing calculations for open-close/throttling and modulating valves.

2. Shop Drawings

a. Power and control wiring diagrams, including terminals and numbers.

3. Certificates

a. Manufacturer's certificate of compliance.

4. Test and Evaluation Reports

a. Shop testing reports.

B. Closeout Submittals

1. Operation and Maintenance Data

a. Complete operation and maintenance manuals in accordance with Section 01 78 23 – Operating and Maintenance Data.

2. Warranty Documentation

a. Copy of manufacturer's warranty on company letter specifically indicating Owner's warranty coverage.

1.3 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers

a. Valves and equipment furnished under this section shall be the product of firms regularly engaged in the design and manufacture of such equipment for a minimum of five (5) years.

2. Installers/Applicators/Erectors

a. Have installation, calibration and testing of valves and equipment furnished under this section performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

B. Certifications

1. Furnish a written certification to the Engineer that all valves comply with all applicable requirements of the governing AWWA standards specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Complete drain valves prior to delivery.

2. Protect ends of flanged and mechanical joint valves with full size wooden baffles securely bolted to the valve ends. Make the baffle size at least equal to the outside diameter of the flange.

B. Storage and Handling Requirements

1. Secure valves sized 24-inch and larger to wooden skids to facilitate handling and storage.

1.5 WARRANTY

A. Manufacturer Warranty

1. Provide a warranty against defective or deficient equipment, workmanship and materials for a period of five (5) years under normal use, operation and service. Provide the warranty in printed form and apply to all similar units.

PART 2 PRODUCTS

2.1 GENERAL

A. Note that all valves, especially in the smaller sizes, are not necessarily shown completely on the drawings, which are more or less schematic. However, Furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.

B. Coordinate the location and position of valve operators. Clearly show the operator position for each valve in the shop drawings.

C. Cast the word “OPEN”, an arrow indicating the direction to open, and flow direction arrows on each valve body.

2.2 GATE VALVES

A. Gate valves shall conform to the latest requirements of AWWA C509 for resilient-seated gate valves, and shall be as manufactured by American Flow Control, U.S. Pipe, M&H, or Engineer approved equal.

B. Gate valves shall be hand operated, non-rising stem, and bronze mounted of the resilient seat type with cast or ductile iron bodies, and adapted for joints as indicated on the Drawings, or as directed by the Engineer.

C. All gate valves shall open by turning the operating nut to the left (counter-clockwise).

D. Valve stems shall be manganese bronze with the collar cast solid with the stem. The threads of stems and stem nuts shall be of the square or Acme type. The ultimate tensile strength shall not be less than 65,000 pounds per square inch and an elastic limit of not less than one-half (½) of the ultimate tensile strength.

E. Valves shall be provided with ‘O’ ring seals. Ring seal plate shall be fitted with two (2) ‘O’ rings: the upper ring serving as a dirt seat, the lower ring as a pressure seal. Design shall permit replacement of ‘O’ rings while the valve is under pressure in the fully opened position. ‘O’ rings shall be Precision Rubber Products Corporation, Quality Compound No. 122-70, or approved equal.

2.3 BALL VALVES

A. Small Ball Valves (3” and Smaller)

1. General

a. Unless otherwise specified, provide quarter-turn type small ball valves with full pipe size opening through the valve. Provide valves suitable for a differential working pressure in either direction of not less than 400 PSI.

b. Manufacturers

1) Apollo 70-100 Series.

2) Engineer approved equal.

2. Construction

a. Unless otherwise specified or required, small ball valves shall have brass body, self-aligning Type 316 stainless steel ball, blow-out proof Type 316 stainless steel stem, reinforced Teflon seats and seals, plastic-coated Type 304 stainless steel handle, and threaded ends per ANSI B2.1.

B. Large Ball Valves (4" and Larger)

1. General

a. Provide metal to metal seated ball valves with flanged ends, drilled to the applicable ANSI B16.1 standard Class 125/150, as required. Valve shall have a clear unobstructed waterway, which will result in no significant head loss, when the valve is in the full open position.

b. The valve shall be drop tight and meet or exceed the AWWA C-507-99 inspection and testing standard. The valve shall be single seated, as required and rated at 150 psi.

c. Manufactures

1) Henry Pratt Company.

2) Apco Willamette.

3) Engineer approved equal.

2. Elements

a. Body

1) Construct body of ductile iron ASTM A536 GR 65-45-12 having an inlet and outlet flanged waterway equal to the required valve size. Use flat-faced flanges machined parallel to each other to within .005 inch. Provide valve body with both a drain and vent hole drilled and tapped.

2) Bearings: Bronze, installed in each half of the valve body accurately located in the center of the housing to receive the trunnion bearings on the ball and place the ball in the central position.

3) Bearing Load: Maximum of 2000 lb/sq. inch at 250 psi differential pressure.

4) Body Seat: Monel, electronically fused to the base metal, then accurately machined to form the seating seal, or other C507-99 approved materials. The body seat shall not protrude into the waterway.

b. Ball

1) Provide a ductile iron ASTM A536 GR 65-45-12 ball with integrally cast trunnions which will be bronze-bushed. One trunnion holds the operating shaft which passes through a packing seal area and connects to the actuator. To prevent leakage around the shaft, the chevron packing is installed to form a seal.

2) Ball Seat: Type 300 series stainless steel. Pressure assisted design. Fully adjustable and replaceable in the field without removing the valve from the line. Use an offset on the body and ball so that the seats will only be in contact at the actual point of closing. Connect the seat to the ball by means of a stainless steel mounting ring that is securely attached and pinned into position

after the correct setting has been attained. Do not use seats threaded directly on to the ball.

3) The ball seat shall be located at the top, when the valve is in the open position.

c. Actuator

1) Provide valve actuators conforming to the operating requirements of AWWA Standard C507-99. Design actuators to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering.

2) Where indicated, provide electric valve actuators meeting the requirements of this specification.

3. Materials

a. Ball and Body Trunnion Bearings: Bronze of dissimilar hardness as per AWWA C507-99 standard to prevent galling or binding. Self-lubricating teflon reinforced are also acceptable.

b. Shafts: ASTM A564 Type 630, H1150 (17-4PH) stainless steel.

c. Valve Testing: Subject all ball valves to hydrostatic, shop leakage and performance tests as specified in AWWA Standard C507-99. Maximum seat leakage allowance of 1fl. oz. per diameter inch per hour as per AWWA C507-99 at the operating pressures indicated in the Valve Schedule.

d. Internal Valve Painting: Shop paint all internal ductile iron surfaces, except finished or bearing surfaces, with two coats of asphalt varnish conforming to Federal Specification TT-C-494, and AWWA C550.

e. External Valve Painting: Shop paint all exterior steel or cast or ductile iron surfaces of each valve, except finished or bearing surfaces, with one or more coats of Alkyd primer. For buried service valves, two coats of asphalt varnish per Federal Specification TT-C-494.

4. Service

a. Provide ball valves suitable for low pressure service while maintaining AWWA leakage limits. Available seating pressure may range as shown in the Valve Schedule at the end of this section depending on the operating status of the associated pump station and the valve must remain leak tight. On initial pump start-up and shut down, the valve may experience pressures up to the high pressures indicated in the schedule prior to opening and closing and shall maintain AWWA leakage standards.

5. Certification

a. Conduct factory testing to certify the valve meets the AWWA leakage standards at the design operating pressures listed in the Valve Schedule. Video tape the testing with a copy provided to the Engineer and Owner. Prior to the valve being shipped to the project site, provide a signed certification from the manufacturer stating the valve meets the AWWA leakage requirements.

2.4 ELECTRIC ACTUATED BUTTERFLY VALVE

A. Provide electric actuated butterfly valves to serve as control check valves for the backwash pumps as shown on the Drawings and specified herein.

B. Provide butterfly valves which meet or exceed the requirements of the latest revision of AWWA Standard C504 for Class 150B butterfly valves and the requirements of NSF/ANSI 61/372.

C. Body

1. Provide ASTM A126 Class B Cast Iron or ASTM A536 Ductile Iron bodies.
2. Flanged end valves shall be of the AWWA C504 short body design with Class 125 flanged ends faced and drilled per ASME B16.1 standard for cast iron flanges.

D. Disc

1. Provide an offset disc which provides an uninterrupted 360 degree seating edge.
2. Disc shall be ductile iron ASTM A536 (65-45-12).
3. Securely attach the disc to the valve shaft utilizing a field removable/replaceable 316 stainless steel torque screw on sizes 3-12" (80-300mm) or a tangential pin locked in place with a set screw on sizes 14-20" (350-500mm).
4. Provide disc edges of solid ASTM A276, type 316 stainless steel.

E. Valve Shaft

1. Provide ASTM A276, type 316 stainless steel valve shafts with self-compensating V-type packing with a minimum of four sealing rings.

F. Seat

1. Provide Acrylonitrile-Butadiene (NBR) seats which are molded in and vulcanized to the valve body.
2. The seat shall contain an integral shaft seal protecting the valve bearings and packing from any line debris.
3. Seats vulcanized to cartridge inserts in the valve body and seats on the disc are not acceptable.

G. Shaft Bearings

1. Provide non-metallic and permanently lubricated bearings.

H. Coatings

1. Coat exterior and interior metallic surfaces of each valve per the latest revision of AWWA C504.
2. The interior of the body shall have a full rubber lining vulcanized to the valve body.

I. Actuators

1. Size actuators to the required operating conditions.
2. Provide electric actuators to control the opening and closing of the valve in accordance with the pump operation. Pump shall start against the closed valve and the valve slowly open as the pump ramps up in speed. Valve shall close against the operating pump, with the pump ramping down and shutting off when the valve is 95% closed.
3. Enclosure: NEMA 4X weather proof enclosure meeting requirements of IP67.
4. Power Supply: 120V, single phase, 60 Hz
5. Control Power: 120V, single phase, 60 Hz

6. Motor: Squire cage induction
7. Limit Switches: two (2) each for Open and Close
8. Torque Switches: one (1) each for Open and Close
9. Provide declutchable, self-locking worm gear drive.
10. Provide a position indicator to provide continuous position of the valve to the control system.

J. Manufacturers

1. Acceptable manufacturers include:
   a. Dezurik/Apco
   b. Pratt
   c. Engineer approved equal

2.5 AIR RELEASE VALVES

A. Furnish materials which are new, unused, and as specified.

B. Air Release and Vacuum Relief Valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both air release and air/vacuum valves and furnished as a single body.

C. Combination Air Valves shall be Golden-Anderson, Valmatic, or Owner approved equal.

D. Valves shall be Manufactured and tested in accordance with AWWA C512. Valves shall be certified to ANSI/NSF 61.

E. Valve shall provide a through flow area equal to the nominal size. Floats shall be unconditionally guaranteed against failure including pressure surges. The cover shall be bolted to the body and sealed with a flat gasket. A resilient bumper shall be provided on 4-inch and larger sizes to cushion the float during sudden opening conditions. The resilent seat shall be replaceable and provide drip tight shut off to the full valve pressure rating.

F. The air release valve shall have a leverage mechanism with sufficient mechanical advantage so that the valve will open under full operating pressure. Simple lever designs shall consist of a single pivot arm and a resilient orifice button. Compound lever designs shall consist of two levers and an adjustable threaded resilient orifice button.

G. The valve body and cover shall be constructed of ASTM A126 Class B cast iron for Class 125 and Class 250 valves. Class 300 ductile iron valves shall be constructed of ASTM A536 Grade 65-45-12 ductile iron. The float, guide shafts, and bushings shall be constructed of Type 316 stainless steel. Non-metallic floats, linkage, or bushings are not acceptable. Resilient seat shall be Buna-N.

H. Operation of the valve shall be as follows:

1. Valves shall not exhibit leaks or weeping of liquid past the large orifice seal at operating pressures of 7.3 psi to twice rated working pressure.
2. Valves shall respond to the presence of air/gas by discharging it through the small orifice at any pressures within a specified design range, 7.3 psi to 250 psi and shall remain leak tight in the absence of air.

3. Valves shall react immediately to pipeline drainage or liquid column separation by the full opening of the large orifice so as to allow unobstructed air intake at the lowest possible negative internal pipeline pressure.

2.6 EXTENSION STEMS

A. Provide solid steel extension stems not smaller than the stem of the valve. Connect extension stems to the valve by a flexible socket coupling. All couplings shall be pinned, keyed, or socket type.

B. Extend extension stems for buried service valves to within 6” of the top of the valve box or floor box. Provide spacers which will center the stem in the valve box. Provide a standard 2” nut on the top of the extension stem.

C. Provide stem guides that are bronze-bushed, cast iron construction adjustable in two directions. Install stem guides so the unsupported length of the extension stem does not exceed 10 feet or an L/r of 200.

2.7 FLOOR STANDS

A. Provide heavy-pattern type floorstands constructed of cast iron or steel with a height of approximately 36 inches. Provide an integral bottom flange suitable for bolting to a concrete floor.

B. Furnish floorstands for manually operated non-rising stem valves with a slot-type position indicator in the floorstand body. Provide a removable stem cover with slot type position indicator for floorstands for rising stem valves. Stem covers shall consist of a galvanized, slotted steel pipe attached to the top of the floorstand with a pointer riding up and down in the slot. Mark the open and closed points on the pipe cover.

C. Provide a bronze operating nut supported by tapered, grease-lubricated roller or ball bearings on floorstands for rising stem valves. Provide positive mechanical seals on the operating nut where it passes through the floorstand housing to retain lubricant and exclude dirt. Provide a lubricating fitting for lubricating bearings.

D. Provide handwheels with a minimum diameter of 14 inches and shall be designed to seat or unseat the valve at the maximum differential with not greater than a 40-pound tangential pull on the handwheel rim. Cast an arrow and the word "OPEN" on the handwheel in raised letters.

E. Provide a conspicuous, permanently attached nameplate showing the valve manufacturer's name, valve size, model designation, serial number, and any other pertinent information on the floorstand. Fabricate the nameplate of corrosion resisting metal with raised or stamped lettering and contrasting background.

F. Set floorstands vertical and plumb with the valve operating stem for free operation without binding or distortion. Shim and grout floorstand in place as required for proper installation.

G. Following manufacture, interior and exterior, non-machined, nonbearing ferrous floorstand surfaces shall be blast-cleaned and painted at the factory with 1 coat of zinc chromate primer conforming to Federal Specification TT-P-645 and 1 coat of compatible alkyd enamel. Protect interior surfaces of floorstands for the life of the unit with a minimum of 3 coats of an approved paint.

2.8 VALVE BOXES

A. Provide all buried valves with 3-piece, cast iron, extension sleeve type valve boxes suitable for the depth of cover as shown on the Drawings.

B. Material Characteristics

1. Minimum Diameter: 5 inches.

2. Minimum Wall Thickness: 3/16” at any point.

C. Cast thereon an appropriate name designating the service for which the valve is intended on the cover (“W” for water, “S” for sanitary).

D. When installed within a roadway, provide deep locking type covers.

E. Heavily coat all parts of valve boxes, bases, and covers with a suitable bituminous finish.

F. Set valves and valve boxes plumb. Place each valve box directly over the valve it serves with the top of the box flush with the finished grade.

2.9 MANUAL VALVE OPERATORS

A. Unless otherwise shown or specified, furnish gate valves with manual operators as follows:

1. Gate valves 8” and smaller that are installed above grade and less than 7 feet above the working surface: Handwheel operator.

2. Gate valves greater than 8” that are installed above grade and less than 7 feet above the working surface: Rotary operator with handwheel.

3. Gate valves 8” and smaller that are installed for buried service: 2” operating nut, extension stem, and valve box.

4. Gate valves greater than 8” that are installed for buried service: Rotary operator with extension stem, 2” operating nut, and valve box.

B. Operating Nuts for Buried Valves: Standard 2” square nuts conforming to AWWA C500. Furnish extension stems, valve boxes, and stem guides where shown, specified, or required for proper operation.

C. Rotary Manual Operators for Aboveground Service: Worm gear or traveling nut type with a heavy-duty, weatherproof cast iron or steel housing with gasketed, removable cover. Equip with a mechanical dial or slot type position indicator and suitable hand wheel. Provide totally enclosed and sealed manual operators to prevent the entrance of rain, dirt, and corrosive atmospheres. Provide traveling nut operators with a grease lubricated alloy steel screw stem, brass nut, and self-lubricating bronze bushings. Provide worm gear operators with hardened, grease-lubricated alloy steel worms and bronze worm gears. Provide bronze or stainless steel exterior bolts and fasteners for corrosion resistance. The valve shall open with counterclockwise rotation of the handwheel.

D. Rotary Manual Operators for Buried Service: Conform with the paragraph above except, provide totally enclosed and completely sealed operator to prevent the entrance of water and dirt. Coat buried operators with a bituminous coating. Capable of withstanding 300 foot-pounds of torque on the operating nut or hand wheel. Provide a corrosion resistant, dial type valve position indicator at the operating nut on the extension stem of the buried operators to provide a remote indication of valve position.

E. Provide manual rotary and handwheel operators capable of seating or unseating the valve disc under the most adverse conditions in the particular application with no more than an 80-pound pull on the handwheel. Comply with all applicable requirements of AWWA C509.

F. Coordinate the location of valve operators. Clearly show operator locations for each valve on the shop drawings.

2.10 PAINTING

A. All valves where not constructed of brass, bronze, or of finished steel shall be painted at the point of manufacture in accordance with AWWA Specifications for Painting, Ductile, Cast Iron Water Pipes, and Fittings, except machined surfaces, which shall be given a suitable coating of grease or other protective material.

2.11 SHOP TESTING

A. All valves shall be tested at the point of manufacture in accordance with the specific AWWA Standard for that size and type of valve and made drop-tight when tested under the hydrostatic head specified herein. After the valves have been set in place, and are ready to operate, the Contractor shall hydrostatically field-test each valve as part of the hydrostatic test of the main. Any valve not proved to be "bubble-tight", shall either be repaired to make it so, or be removed from the line and replaced. Valves repaired or replaced shall be re-tested for leakage prior to acceptance by Owner.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all valves and appurtenances in strict conformance with the drawings and manufacturer's instructions.

B. Install valves in such a way that operators and packing are easily accessible. Install valves with field replaceable seats with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.2 SHOP AND FIELD TESTING

A. Provide certified factory testing for all components of the valve and operator system. Shop test valves and operators in accordance with the requirements in the latest revision of AWWA C500, including performance tests, leakage test, hydrostatic tests, and proof-of-design tests. Submit certified copies of the reports covering the test for acceptance by the Engineer.

B. Provide shop testing for the operators consisting of a complete functional check of each unit. Correct any deficiencies found in shop testing prior to shipment. Submit written certification that shop tests for the electrical system and all controls were successfully conducted and that these components provide the functions specified and required for proper operation of the valve operator system.

C. Conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Conduct preliminary field tests prior to start-up with final field tests conducted during start-up. Have the factory service representative assist during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. Have the service representative certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

D. Following installation, test all valves under the anticipated operating conditions. Demonstrate the ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque to the satisfaction of the Engineer. Adjust and/or replace any valve as necessary to assure satisfactory operation.

E. Conduct preliminary and final field tests at a time approved by the Engineer and Owner. The Engineer and/or Owner shall witness all field testing.

F. Pay all costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

G. Conduct preliminary field tests prior to start-up and shall include a functional check of the entire valve operator system and all system components. Demonstrate that the valve operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly during the preliminary field tests. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

H. Conduct final field acceptance tests simultaneously with the start-up and field testing of the pumps, air compressors, process air blowers, etc. Conduct field tests for the full range of operating modes and conditions specified and as directed by the Engineer. Test each of the valves at minimum, maximum, and normal head/flow conditions, and under all specified conditions of opening and closing. Check performance of pneumatic valves and compressed air system under normal operating conditions and during simulated power failures.

I. Include optimization of opening and closing times of the valves during field testing. Provide the means for accurate measurement of pipeline pressures as directed by the Engineer. Adjust valve opening and closing times based on process requirements to optimize operation of the valves. Final valve opening and closing times as determined by field tests shall be approved by the Engineer prior to final acceptance of the system.

3.3 VALVE SCHEDULE

Location	Type	Size	Quantity	Actuator Type	Upstream Operating Pressures (psi)	Downstream Operating Pressures (psi)
6.0 MG Clearwell Fill	Gate	18”	1	Manual Buried with Rotary Nut	10	15
2.0 MG Clearwell Fill	Gate	18”	1	Manual Buried with Rotary Nut	10	15
6.0 MG Clearwell Outlet	Gate	54”	1	Manual Rotary with Nut	15	15
6.0 MG Clearwell Outlet	Gate	24”	1	Manual Buried with Rotary Nut	15	15
2.0 MG Clearwell Fill	Tapping Gate	24”	1	Manual Buried with Rotary Nut	15	15
Backwash Pump Control	Electric Actuated Butterfly	12”	2	Electric	15	15
Backwash Pump Isolation	Butterfly	12”	2	Manual with Handwheel	15	15

END OF SECTION

SECTION 33 12 16.13

ALTITUDE CONTROL VALVE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
1.3	Quality Assurance
1.4	Delivery, Storage, and Handling
1.5	Warranty
2.1	General
2.2	Gate Valves
2.3	Ball Valves
2.4	Electric Actuated Butterfly Valves
2.5	Air Release Valves
2.6	Extension Stems
2.7	Floor Stands
2.8	Valve Boxes
2.9	Manual Valve Operators
2.10	Painting
2.11	Shop Testing
3.1	Installation
3.2	Shop and Field Testing
3.3	Valve Schedule

B. Scope

1. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation altitude control valves for the control of the water level in the existing clearwells as shown on the Drawings and/or specified herein.

1.2 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data

a. Product data sheets for each make and model. Indicate valve type number, applicable tag number, and facility name/number or service where used.

b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.

c. Specific information on all operational features.

d. Computerized cavitation analysis report which shows flow rate, differential pressure, and percentage of valve opening. Cv factor, system velocity, and if there will be cavitation damage.

e. Provide valve noise levels according to International Standards over the flow range of the valve. Noise calculation program will be specific to the control valve manufacturer, and based upon tests conducted by a third party, independent laboratory, and will be able to provide dBA values for octave band frequencies between 31.5 and 8000 Hz. (Valves with KO trim calculations are per another industry accepted standard without the octave band frequency noise levels). Generic, third-party noise calculation for non-specific control valves will not be accepted.

2. Shop Drawings

a. Detailed drawings showing the dimensions, configuration, pilot operating system, and construction of the valves.

3. Certificates

a. Manufacturer's certificate of compliance.

4. Test and Evaluation Reports

a. Shop testing reports.

B. Closeout Submittals

1. Operation and Maintenance Data

a. Complete operation and maintenance manuals in accordance with Section 01 78 23 – Operating and Maintenance Data.

2. Warranty Documentation

a. Copy of manufacturer's warranty on company letter specifically indicating Owner's warranty coverage.

1.3 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers

a. Valves and equipment furnished under this section shall be the product of firms regularly engaged in the design and manufacture of such equipment for a minimum of five (5) years.

2. Installers/Applicators/Erectors

a. Have installation, calibration and testing of valves and equipment furnished under this section performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

B. Certifications

1. Furnish a written certification to the Engineer that all valves comply with all applicable requirements of the governing AWWA standards specified herein.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing

1. Control valves specified herein shall be factory assembled. Any control valve appurtenances, accessories, parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.

2. Prior to shipping, the control valves and all associated accessories shall be acceptably packaged and covered to prevent entry of foreign material.

B. Delivery and Acceptance Requirements

1. Completely drain valves prior to delivery.

2. Protect ends of flanged and mechanical joint valves with full size wooden baffles securely bolted to the valve ends. Make the baffle size at least equal to the outside diameter of the flange.

3. Care shall be taken in loading, transporting and unloading to protect control valves, appurtenances, or coatings from damage. Equipment shall not be dropped. All control valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage shall be repaired.

C. Storage and Handling Requirements

1. Secure valves sized 24-inch and larger to wooden skids to facilitate handling and storage.

1.5 WARRANTY

A. Manufacturer Warranty

1. Provide a warranty against defective or deficient equipment, workmanship and materials for a period of three (3) years from date of acceptance under normal use, operation and service. Provide the warranty in printed form and apply to all similar units.

PART 2 PRODUCTS

2.1 FUNCTION

A. The valve shall control the high-water level in the clearwell without the need for floats or other devices. It shall be a non-throttling type valve (either fully open or fully closed). The valve remains fully open; allowing normal flow to fill the reservoir until the maximum level shut-off point is reached and then closes drip tight at the set point. The valve automatically opens to refill the reservoir once the level drops a fixed distance below the high-water level. Design the valve for one-way flow only.

2.2 MATERIALS

A. Furnish valves manufactured of the following materials.

1. Body and Cover: Ductile Iron ASTM A536
2. Main Valve Trim: Type 316 Stainless Steel
3. Seat: Type 316 Stainless Steel
4. Stem, Nut , and Spring: Type 316 Stainless Steel
5. Seal Disc: Buna-N Rubber
6. Diaphragm: Nylon Reinforce Buna-N Rubber
7. Internal Trim Parts: Type 316 Stainless Steel, Bronze, and Brass
8. End Connections: Flanged
9. Pressure Rating: Class 150 lb.
10. Temperature Range: Up to 180°F
11. Coating: Fusion Bonded Epoxy meeting ANSI/NSF 61 and AWWA C116-03

2.3 MANUFACTURE

A. Main Valve

1. The main valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.

B. Main Valve End Connections

1. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150.

C. Main Valve Body

1. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
2. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the discs firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hour-glass shaped disc retainers shall be permitted, and no V-type or slotted-type disc guides shall be used.
3. The diaphragm assembly containing a non-magnetic stainless-steel stem; of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the main valve cover and an integral bearing in the valve seat. The

valve seat shall be a solid, one-piece design and shall have a minimum five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from the line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.

4. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm's center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 X per layer of nylon fabric and shall be cycled tested 100,000 times to ensure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position. Bellofram type rolling diaphragms shall not be permitted.

5. The main valve seat and stem bearing in the valve cover shall be removable. The cover bearing and seat in the 6" and smaller size valve shall be threaded into the cover and body. The valve seat in the 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To ensure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc guide and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one-piece design. Two-piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

D. Pilot Control System

1. The pilot control shall be of a diaphragm-actuated, three-way type that operates on the differential force between the height of the water in the clearwell and an adjustable spring-load. The spring-load shall be an arrangement of smaller springs on a plate within the control. When actuated, the pilot control shall vent the cover of the main valve to atmosphere through the internal working of the pilot control to open the valve wide. When the desired level in the clearwell is reached, the static height of the tank shall head through a customer supplied sensing line connected directly to the reservoir. When the control shifts at high water level supply pressure shall be directed into the valve cover through the internal workings of the pilot control to close the valve. The pilot control senses the reservoir head by means of a sensing line connected between the pilot control and the clearwell. The pilot control shall be bracket mounted to the main valve.

2. A valve position indicator shall be installed on the main valve cover and shall consist of a brass indicator rod fastened to the main valve stem which moves up and down

inside a clear Pyrex tube contained in a bar brass housing open on two sides to permit clear vision of the brass indicator rod.

3. The pilot control system shall include a strainer, closing speed needle valve and all required control accessories, equipment, control tubing and fittings. The pilot system shall include isolation ball valves on sizes 4" and larger as standard equipment. Five different adjustment spring settings shall be available, in ranges of 5 to 50 feet. Pilot to be manufactured by control valve manufacturer.
4. Material Specification for Pilot Control System:
   a. Altitude Pilot Control
      1) Pilot Body and Cover: Bronze, low lead CuZn21Si3P or UNS C87850
      2) Pilot Trim: Brass and Type 316 Stainless Steel
      3) Seals and Diaphragm: Nitrile
      4) Connections: FNPT
      5) Pressure Rating: 150 psi max.
      6) Temperature Rating: Up to 180°F
   b. Control Tubing: Copper
   c. Control Fittings: Brass

E. Factory Assembly
1. Each control valve shall be factory assembled.
2. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
3. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.
4. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects.

F. Name Plates
1. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.
2. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.
3. Nameplates shall be brass and a minimum of 3/32" thick, ¾" high and 2-3/4" long.
4. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end-connection details, type of pilot controls used and control adjustment range.

G. Factory Testing
1. Each control valve shall be factory tested.
2. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
3. Tests shall conform to approved test procedures.

4. The standard factory tests shall include a valve body and cover leakage test, seat leakage test and a stroke test. Control valves and pilot valves, in the partially open position, with both ends closed off with blind flanges (valves) and pipe plugs (pilots), shall be subject to an air test. The applied air pressure shall be 90 psi minimum. All air pressure tests shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the valve seat, the pressure boundary walls of the valve body, valve cover, pilot body, pilot cover or the body-cover joint.
5. Control valve manufacturer shall, upon request, offer additional testing, such as high-pressure hydrostatic testing, positive material inspection testing, ferrite testing, liquid penetration inspection testing, magnetic particle examination testing and radiographic examination testing.

2.4 PAINTING

A. All valves where not constructed of brass, bronze, or of finished steel shall be painted at the point of manufacture in accordance with AWWA Specifications for Painting, Ductile, Cast Iron Water Pipes, and Fittings, except machined surfaces, which shall be given a suitable coating of grease or other protective material.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install all valves and appurtenances in strict conformance with the drawings and manufacturer's instructions.

B. Install valves in such a way that operators and packing are easily accessible. Install valves with field replaceable seats with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.2 FIELD TESTING

A. Conduct field tests to check and adjust system components, and to test and adjust operation of the overall system. Conduct preliminary field tests prior to start-up with final field tests conducted during start-up. Have the factory service representative assist during all field testing and prepare a written report describing test methods, and changes made during the testing, and summarizing test results. Have the service representative certify proper operation of the valve operator system upon successful completion of the final acceptance field testing.

B. Following installation, test all valves under the anticipated operating conditions. Demonstrate the ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque to the satisfaction of the Engineer. Adjust and/or replace any valve as necessary to assure satisfactory operation.

C. Conduct preliminary and final field tests at a time approved by the Engineer and Owner. The Engineer and/or Owner shall witness all field testing.

D. Pay all costs in connection with field testing of equipment such as energy, light, lubricants, water, instruments, labor, equipment, temporary facilities for test purposes, etc. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when the Owner formally takes over the operation thereof.

E. Conduct preliminary field tests prior to start-up and shall include a functional check of the entire valve operator system and all system components. Demonstrate that the valve

operator system performs according to specifications and that all equipment, valves, controls, alarms, interlocks, etc., function properly during the preliminary field tests. The preliminary field test report must be approved by the Engineer prior to conducting final field acceptance tests. Based on results of preliminary field tests, make any adjustments required to settings, etc., to achieve the required valve closing time and operation specified or otherwise directed by the Engineer.

END OF SECTION

SECTION 33 16 32

PRESTRESSED CONCRETE STORAGE TANK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	References
1.3	Submittals
1.4	Quality Assurance
1.5	Warranty
2.1	Design Criteria
2.2	Performance
2.3	Concrete
2.4	Shotcrete
2.5	Moisture Barrier
2.6	Prestressed Reinforcement
2.7	Non-Prestressed Reinforcement
2.8	Galvanized Steel Diaphragm
2.9	PVC Waterstops, Bearing Pads, and Sponge Filler
2.10	Epoxy
2.11	Seismic Restraint Cables
2.12	Tank Accessories
2.13	Coatings
3.1	Examination
3.2	Installation
3.3	Field Quality Control
3.4	Cleaning and Disinfection

B. Scope

1. This section specifies the design and construction of an ANSI/AWWA D110 wire-wound prestressed concrete storage tank with a Type II core wall and galvanized steel diaphragm including reinforced concrete dome, membrane floor and all reinforcing, concrete work, accessories, disinfection and testing directly related to the tank.
2. The tank contractor is responsible for furnishing all labor, materials, tools and equipment necessary to design and construct the prestressed concrete storage tank, including all exterior coatings, as indicated on the drawings and as described in this specification.

1.2 REFERENCES

A. ACI 117 Specification for Tolerances for Concrete Construction and Materials

B. ACI 301/301M – Specifications for Structural Concrete for Buildings.

C. ACI 305R – Guide to Hot Weather Concreting.

D. ACI 306R – Guide to Cold Weather Concreting.

E. ACI 347R – Guide to Formwork for Concrete.

F. ACI 350/350R – Code Requirements for Environmental Engineering Concrete Structures and Commentary.

G. ACI 350.3 – Seismic Design of Liquid-Containing Concrete Structures and Commentary.

H. ACI 372R – Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures.

I. ACI 506R – Guide to Shotcrete.

J. ACI 506.2 – Specification for Materials, Proportioning, and Application of Shotcrete.

K. ACI SP4: Formwork for Concrete.

L. ANSI/AWWA C652 – Disinfection of Water Storage Facilities.

M. ANSI/AWWA D110 – Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks.

N. ASCE Standard 7 – Minimum Design Loads for Buildings and Other Structures.

O. ASTM A416/A416M – Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

P. ASTM A475/475M – Standard Specification for Zinc-Coated Steel Wire Strand.

Q. ASTM A603/603M – Standard Specification for Zinc-Coated Steel Structural Wire Rope.

R. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

S. ASTM A653/653M – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by Hot Dip Process.

T. ASTM A821/A821M – Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks.

U. ASTM A884/A884M – Standard Specification for Epoxy Coated Steel Wire and Welded Wire Reinforcement.

V. ASTM A1064/A1064M – Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

W. ASTM C31/C31M – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

X. ASTM C33/C33M – Standard Specification for Concrete Aggregates.

Y. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

Z. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic-Cement.

AA. ASTM C172/C172M – Standard Practice for Sampling Freshly Mixed Concrete.

BB. ASTM C231/C231M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

CC. ASTM C881/C881M – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

DD. ASTM D1056 – Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

EE. ASTM D1557 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

FF. ASTM D4397 – Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

GG. ASTM F593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

HH. AWS D1.2 – Structural Welding Code – Aluminum.

II. "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard" by P.K. Malhotra, Structural Engineering International, IASBSE, 3/2006 pp 222-225.

JJ. OSHA 29 CFR 1910 – OSHA General Industry Regulations.

KK. U.S. Army Corps of Engineers CRD-C-572-74 – Specification for Polyvinylchloride (PVC) Waterstop

LL. AMPP-QP8 Installation of Polymer Coatings and Surfacings on Concrete.

MM. SSPC-SP 13/ NACE 6 Surface Preparation of Concrete.

NN. ICRI 310.2R-2013 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays and Concrete Repair.

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

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data

   a. Design Data: Submit structural calculations for the tank, signed and sealed by a professional engineer in accordance with Section 1.5 A.4 of this specification.

   b. Concrete Data: Submit concrete design mixes including ingredient proportions, minimum cementitious content, and water/cementitious ratio in accordance with Section 2.2 and 2.3 of this specification.

   c. Coating Data: Submit color charts for review by the engineer and owner. Once a color is chosen, submit actual drawdown samples for final approval prior to application of coating.

2. Shop Drawings

   a. Provide shop drawings with a minimum size of 18” x 24” with a complete plan, elevation, and sectional views showing critical dimension as follows:

      1) Size, location and number of all reinforcing bars.

      2) Thickness of all parts of the tank structure including floor, core wall, dome and covercoat.

3) Prestressing schedule including number and placement of prestressing wires on the tank wall and total applied per foot of wall height.

4) Location and details of all accessories required.

3. Certificates

a. Manufacturer's certificate of compliance.

4. Test and Evaluation Reports

a. Submit concrete strength reports for 7-day and 28-day breaks taken in accordance with the requirements of Section 3.3 A.1.

b. Submit a cleaning and disinfection plan which complies with Section 3.4 of this specification.

B. Closeout Submittals

1. Record Documents

a. Furnish record documents in accordance with Section 01 78 39 – Record Documents.

b. Record actual location layout and final configuration of tank and accessories on shop drawings and submit to engineer after construction of the tank is complete.

2. Warranty Documentation

a. Copy of manufacturer's warranty on company letter specifically indicating Owner's warranty coverage.

b. Submit warranty document in Owner's name in accordance with Section 1.6. of this specification.

1.4 QUALITY ASSURANCE

A. Qualifications and Experience

1. Tank Construction Company: Shall be a firm with a minimum of five (5) years of experience in the design and construction of ANSI/AWWA D110 wire-wound, circular prestressed concrete tanks with Type II core walls to ensure the owner that it has the organization, technical skill, quality control, reliability, and financial stability to build and guarantee the tank in accordance with the quality required by these specifications. The tank construction company shall have built with its own resources and have under warranty, a minimum of ten (10) dome-covered prestressed concrete tanks of equal or greater size than that required for this project which meet these specifications and are now providing satisfactory service.

2. Construction: The entire tank, including all portions of the floor, wall, and roof shall be built by the tank construction company, using its own trained personnel and equipment.

3. Coatings: All Coating, Surface Preparation and Related Coating work shall be accomplished by an AMPP QP8 Certified Contractor. All tank coatings shall be included in the scope of the AMPP QP8 tank construction company. Subcontracting of this work is not allowed.

4. Design: All design work for the tank shall be performed by a professional engineer with no less than five years of experience in the design and construction of ANSI/AWWA D110 wire-wound, circular prestressed concrete tanks with Type II core walls. The professional engineer shall be a full-time staff member of the tank

construction company and shall be licensed to work in the state where the project is located.

5. The diaphragm design and epoxy injection procedure shall have been used in the ten tanks required in Section 1.5 A.1 of this specification.

B. Prequalifications

1. All tank construction companies must be prequalified and meet the criteria stated in Section 1.5 A.1 of this specification to be considered an acceptable tank builder.

2. A complete prequalification package shall be submitted to the Engineer for consideration 14 days prior to the date set for receipt of bids. The prequalification submittal shall include the following items:

a. Complete construction drawings showing the principal sizes, thicknesses, reinforcing size and spacing for all structural members including: floor, wall, dome shell and dome edge.

b. Complete details of other structural appurtenances as required by the project drawings showing principal sizes, thickness and reinforcing sizes and spacing.

c. Complete design calculations which address applicable loads provided in Section 1.7 B. of this specification.

d. Complete experience record for the tanks used to meet the experience requirement of Section 1.5 A. of this specification that have been designed and built in the tank construction company's own name and shall include only those tanks that are under the company's warranty. The record shall include the size of the tank, name, address and telephone number of the Owner, the year of construction and the name and telephone number of the Engineer for the project.

e. Experience in prestressed concrete tanks of the type specified herein for the construction superintendent, foreman, and three most experienced tank builders. Experience shall be with the bidder during the three previous years.

f. Construction schedule which details the duration for tank construction.

1.5 WARRANTY

A. The tank construction company shall provide a warranty for workmanship and materials on the complete structural portion of the tank for a five-year period from the date of acceptance of the work. The warranty shall not apply to any accessory, equipment or product that is not a structural part of the tank and is manufactured by a company other than the tank construction company.

B. If any leakage or other defects appear within the five-year period, the tank construction company shall promptly repair the tank at its own expense upon written notice by the Owner that such defects have been found. Leakage is defined as a stream flow of liquid appearing on the exterior of the tank, the source of which is from the inside of the tank. The tank construction company shall not be responsible for, nor liable for, any subsurface condition.

C. The tank construction company shall install all tank coatings and shall provide a warranty for workmanship and materials on all interior and exterior coatings for a five-year period from the date of the acceptance of the work.

D. A coating system failure is defined as either (1) delamination of the coating, (2) a breach of the coating exposing the substrate below, or (3) chipping and peeling of the coating system

not caused by physical damage or abrasion to the tank. Changes in color shall not be deemed a coating failure.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. The design shall be in conformance with applicable portions of American Concrete Institute (ACI) 372R Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, ANSI/AWWA D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks with Type II core walls, and currently accepted engineering principles and practices for the design of such structures.

B. The following loadings shall be utilized in the design:

1. Capacity: 6.0 Million Gallons
2. Dimensions:
   a. Inside Diameter: 160 feet
   b. Water Depth: 40 feet
3. Fluid Loads: Shall be the weight of all liquid when the reservoir is filled to capacity. The unit weight of the liquid material shall be 62.4 lbs/ft^3.
4. Roof Live Loads: Consideration shall be given to all applicable roof design loads in accordance with ANSI/AWWA D110, Section 3.3 and ASCE 7. The minimum roof live load for the structure shall be 20 psf.
5. Dead Loads: Consideration shall be given to all permanent imposed loads including concrete and steel.
6. Seismic Loads:
   a. Seismic forces and moments resulting from water sloshing and seismic accelerations of the tank dome, wall, and water loads shall be calculated in accordance with ACI 350.3 or ANSI/AWWA D110.
   b. If sufficient freeboard height is not provided to prevent uplift forces due to sloshing, the impulsive participation shall be increased due to the constrained motion of liquid, and the tank roof and its connection shall be designed to resist the uplift forces in accordance with P.K. Malhotra's "Earthquake Induced Sloshing in Tanks with Insufficient Freeboard".
7. Soil Pressure: Earth loads shall be determined by rational methods of soil mechanics. Soil pressure shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall.
8. Differential Backfill Loads: Forces from differential backfill loads shall be considered in the design and shall be based on the at-rest coefficient. Passive resistance shall not be used to resist differential backfill loads.
9. Wind Loads: Wind loads shall be considered in the design in accordance with ASCE 7.

C. Subbase: A granular base material shall be used beneath the membrane slab when the subgrade materials do not allow free drainage.

1. The base material should consist of a clean, well-compacted, angular or sub-angular material with a minimum thickness of 6 in.

2. The gradation of the base material should be selected to permit free drainage without the loss of fines or intermixing with the subgrade material.
3. The maximum particle size of the base material should be limited to provide a relatively level working surface without potential intrusion of the base materials into the membrane floor slab concrete.
4. Base material should be compacted to 95 percent of the maximum laboratory density determined by ASTM D1557.

D. Floor: The design of the floor for the prestressed concrete tank shall conform to the following:
1. Concrete membrane floors shall be a minimum of 4" thick and have a minimum thickness of 8" of concrete over all pipe encasements and around sumps.
2. A minimum percentage of 0.60% reinforcing steel shall be used in the membrane floor. The minimum percentage shall apply to all thickened sections and shall extend a minimum of 2 ft into the adjacent membrane floor.

E. Core Wall:
1. The wire-wound, prestressed concrete tank core wall shall be designed as a thin shell cylindrical element using shotcrete and an embedded, mechanically bonded, galvanized steel shell diaphragm.
2. The design of the core wall shall take into account appropriate edge restraint. To compensate for bending moments, shrinkage, differential drying, and temperature stresses, the following minimum reinforcing steel shall be incorporated into the design:
   a. The top 2 ft of core wall shall have not less than 1% circumferential reinforcing.
   b. The bottom 3 ft of core wall shall have not less than 1% circumferential reinforcing.
   c. Inside Face:
      1) The inside face of the core wall shall utilize the diaphragm as effective reinforcing.
      2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.
   d. Outside Face:
      1) Vertical reinforcing steel in the outside face of the core wall shall be: minimum of #4 bars at 12" center to center.
      2) Additional vertical and horizontal reinforcing steel bars shall be used as required by design computations.
3. The minimum core wall thickness shall be 3½".
4. Reinforcing steel used in the core wall shall be designed using a maximum allowable design tensile stress, f_s, of 18,000 psi.
5. Allowable compressive stress in the core wall due to initial prestressing force, f_{gi}, shall be:
   a. 1250 psi + 75t psi/in. with 0.5 f'_{gi} maximum or less (where f'_{gi} is defined as compressive strength at time initial prestressing force is applied and *t* is the thickness of the core wall in inches).

b. Maximum of 2250 psi.

6. Allowable compressive stress in the core wall due to final prestressing force, f_g, shall be:

a. 1250 psi + 75t psi/in. with 0.45 f'_g maximum (where f'_g is defined as compressive strength required for final prestressing force and *t* is the thickness of the core wall in inches).

b. Maximum of 2025 psi.

F. Dome:

1. The dome roof shall be constructed of reinforced concrete and shall be circumferentially prestressed.

2. Dome shell reinforcement shall consist of reinforcing bars or welded wire fabric, not galvanized. Bolsters for wire fabric and reinforcing bars shall be plastic. Wire ties shall be galvanized.

3. The dome ring girder shall be prestressed with sufficient wire to withstand the dome dead load and design live loads. The ring girder shall have cross section suitable to accept the applied prestressing forces.

4. The high water level in the tank shall be permitted to encroach on the dome shell no higher than the upper horizontal plane of the dome ring girder.

5. Overflow outlets or the overflow pipe shall be capable of providing an overflow open area three times the area of the largest influent pipe.

6. Overflow outlets plus the dome ventilator shall be capable of providing an open area three times the area of the largest pipe.

7. The dome shall be designed as a free-span, spherical thin shell with one-tenth rise in accordance with the following:

a. Typical Dome Design: The typical dome thickness and steel reinforcement shall meet the requirements of ANSI/AWWA D110.

b. In all cases, the thickness of the dome shall be no less than 3".

c. Dome Edge Design: The dome edge and upper wall shall be designed to resist the moments, thrusts, and shears that occur in this region due to dome and wall prestressing and loading conditions. The design of the edge region shall conform to the following:

1) Dome Edge Thickness:

a) A determination of the buckle diameter shall be made, as defined by:

$$d_b = 2.5 \cdot \sqrt{r_d \cdot t_d}$$ rounded up to the next foot

Where: d_b = buckle diameter in feet

r_d = dome radius in feet

t_d = typical dome thickness in feet

b) Dome edge thickening shall begin at a radial location on the dome, defined as s_2 which is at least one buckle diameter away from the tank wall.

c) A springline haunch shall be provided, which extends radially from the inside face of the tank wall to radial location s_1 which is defined as:

$$s_1 = 0.6 \cdot \sqrt{1.5 \cdot r_d \cdot t_d}$$ rounded up to the next foot

Where: s_1 = distance from inside face of wall to haunch in feet

s_2 = distance from inside face of wall to typical dome thickness in feet.

This springline haunch shall begin at the inside face of the tank wall with a springline thickness as required by paragraph (f) below and shall end at radial location s_1 with the following thickness:

$$t_{d1} = 1.33 \cdot t_d$$

Where: t_{d1} = minimum thickness at s_1 in feet

t_d = typical dome thickness in feet at one buckle diameter from tank wall

d) Beginning at s_1 and continuing to s_2 the dome shell shall have a uniform straight line taper.

e) Parameters (b), (c), and (d) above are not required for domes where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.

f) Sufficient concrete thickness at the springline of the dome shall be provided so that no more than 2 ft of the springline haunch is considered in calculating the effective dome edge ring cross sectional area. Compressive stress in this area shall not exceed 1000 psi when subjected to initial prestressing, offset by dead load only.

2) Dome Edge Steel Reinforcement:

a) Throughout the dome edge, the percentage of steel reinforcement, both radially and circumferentially, shall be no less than 0.25% of the gross cross sectional area of concrete.

b) Along the dome edge, steel reinforcement shall be distributed between the upper and lower layers unless finite element analysis calculations indicate that tensile stress does not exist in the concrete along the bottom face of the dome edge. In that case, only top bars are required radially and circumferentially. In addition, radial and circumferential reinforcing bars will not be required along the bottom face of the dome edge where the calculated typical dome thickness is less than 75% of the actual typical dome thickness.

c) Where reinforcing bars are required in the bottom layer, they shall be placed near the tank wall to insure adequate development at the intersection between dome and wall.

d) In all cases, the percentage of circumferential steel reinforcement in the effective dome ring shall be no less than one percent of the gross cross sectional area of concrete. The effective dome ring is defined as ¼ of the haunch length not to exceed 2 ft'.

e) Where bottom dome edge steel reinforcement is required, vertical steel reinforcement along the inside face of the tank wall shall be no less than 0.5% of the cross sectional area of wall shotcrete.

G. Prestressing:

1. Circumferential prestressing of the tank shall be achieved by the application of cold-drawn, high-carbon steel wire placed under high tension.
2. A substantial allowance shall be made for prestressing losses due to shrinkage and plastic flow in the shotcrete and due to relaxation in the prestressing steel.
3. The prestressing design shall conform to the following minimum requirements:
   a. Working stress for the tank wall, fs, shall be a maximum of 115,000 psi.
   b. Working stress for the dome ring, fsd, shall be a maximum of 120,000 psi.
   c. The allowable design tensile stress in the prestressing wire before losses, fsi shall be 145,600 psi or no greater than 0.63 fu, where fu is defined as the ultimate strength of the wire.
   d. Areas to be prestressed will contain no fewer than 10 wires per foot of wall for 8 gauge and 8 wires per foot of wall for 6 gauge.
   e. A maximum of 24 wires per layer per foot for 8 gauge and 20 wires per layer per foot for 6 gauge will be allowed.

H. Wall Openings:

1. When it is necessary for a pipe to pass through the tank wall, the invert of such pipe or sleeve shall provide no less than 18" clear space at the bottom of the wall to provide sufficient clear area for the prestressing wires. The prestressing wires required at the pipe elevation shall be distributed into circumferential bands immediately above and below the opening to maintain the required prestressing force while leaving an unbanded strip around the entire tank.
2. Unbanded strips shall have a vertical dimension of no more than 36" unless an axi-symmetric shell analysis is performed to account for compressive forces plus shear and moments caused by displacement of the prestressing wires into adjacent bands.

2.2 PERFORMANCE

A. Performance of the materials used in the tank construction shall conform to the minimum requirements of this specification.

B. Substitutions to the materials in this specification may only be made if submitted in writing and approved by the engineer.

2.3 CONCRETE

A. Concrete shall conform to ACI 301/301M.

B. All concrete shall utilize either Type I/II cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. Admixtures other than air-entraining and water reducing admixtures will not be permitted unless approved by the engineer.

E. Coarse and fine aggregate shall meet the requirements of ASTM C33/C33M.

F. Concrete mixes used in the construction of the tank shall conform to the following:

Mix	Compressive Strength (psi)	Min. Cement Content (lbs.)	AASHTO Aggregate	Max. W/C Ratio	Air Content (%)	Slump (in.)
Floor	4,000	560	#57	0.45	5 ± 1.5	4 ± 1
Dome	4,000	600	#8	0.45	5 ± 1.5	4 ± 1

2.4 SHOTCRETE

A. Shotcrete shall conform to the requirements of ACI 506.2 except as modified herein.

B. All shotcrete mixes shall utilize either Type I/II cement.

C. A maximum of 25% of cementitious material may be fly ash.

D. All shotcrete in contact with diaphragm or prestressing wire shall be proportioned to consist of not more than three parts sand to one part Portland cement by weight. All other shotcrete shall be proportioned to consist of not more than four parts sand to one part Portland cement by weight.

E. Admixtures will not contain more than trace amounts of chlorides, fluorides, sulfides or nitrates.

F. Fine aggregate shall meet the requirements of ASTM C33/C33M.

G. Shotcrete mixes used in the tank construction shall conform to the following:

Mix	Compressive Strength (psi)	Max. W/C Ratio	Air Content (%)	Slump (in.)	Fiber Reinforcement (lbs/cy)
Core Wall	4,000	0.42	5 ± 1.5	5 ± 1	-
Covercoat	4,000	0.42	5 ± 1.5	5 ± 1	-

2.5 MOISTURE BARRIER

A. The moisture barrier shall be polyethylene, Class A, conforming to ASTM D4397 with a minimum thickness of 6-mils.

2.6 PRESTRESSED REINFORCEMENT

A. The prestressing wire shall conform to the requirements of ASTM A821/A821M, Type B.

B. The prestressing wire size shall be 0.162" (8 gauge), 0.192" (6 gauge) or larger, but no larger than 0.250".

C. The ultimate tensile strength, fu shall be, 231,000 psi or greater for 8 gauge wire, 222,000 psi or greater for 6 gauge.

D. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the prestressing reinforcement and shall develop the full strength of the wire.

2.7 NON-PRESTRESSED REINFORCEMENT

A. Non-prestressed mild reinforcing steel shall be new billet steel meeting the requirements of ASTM A615/A615M with a minimum yield strength, f_y, of 60,000 psi. Reinforcement shall comply with Specification Section 03 21 00 – Reinforcing Steel.

B. Welded wire reinforcing shall be plain wire conforming to the requirements of ASTM A1064/A1064M with a minimum yield strength, f_y, of 65,000 psi.

2.8 GALVANIZED STEEL DIAPHRAGM

A. The galvanized steel diaphragm used in the construction of the core wall shall be 26 gauge with a minimum thickness of 0.017 in. conforming to the requirements of ASTM A653/A653M. Weight of zinc coating shall be not less than G90 of Table 1 of ASTM A653/A653M.

B. The diaphragm shall be formed with re-entrant angles and erected so that a mechanical key is created between the shotcrete and diaphragm.

C. The diaphragm shall be continuous to within 3 in. of the top and bottom of the wall. Horizontal joints or splices will not be permitted.

D. All vertical joints in the diaphragm shall be rolled seamed, crimped and sealed watertight using epoxy injection.

E. In all tanks designed to use a waterstop at the floor/wall joint, the steel shell diaphragm shall be epoxy bonded to the waterstop.

2.9 PVC WATERSTOPS, BEARING PADS AND SPONGE FILLER

A. PVC waterstops shall conform to the requirements of Specification Section 03 15 00 – Concrete Joint and Joint Accessories.

B. Plastic waterstops shall be extruded from an elastomeric plastic material of which the base resin is virgin polyvinylchloride (PVC). PVC waterstops shall conform to the requirements of CRD-C-572-74.

C. The profile and size of the waterstop shall be suitable for the hydrostatic pressure and movements to which it is exposed.

D. Bearing pads used in floor/wall joints shall consist of neoprene, natural rubber or polyvinyl chloride.

E. Sponge filler at the floor/wall joint shall be closed-cell neoprene.

2.10 EPOXY

A. Epoxy Sealants:

1. Epoxy shall conform to the requirements of ASTM C881/C881M.

2. Epoxy used for sealing the diaphragm shall be Type III, Grade 1, and shall be 100% solids, moisture insensitive, low modulus epoxy.

3. Epoxy used for placing the waterstop shall be Type II, Grade 2, and shall be 100% solids, moisture insensitive, low exotherm epoxy.

4. When pumped, maximum viscosity of the epoxy shall be 10 poises at 77°F.

B. Bonding Epoxy

1. Epoxy resins used for enhancing the bond between fresh concrete and hardened concrete shall conform to the requirements of ASTM C881/C881M.
2. Epoxy resins shall be a two-component, 100% solids, moisture-insensitive epoxy and shall be Type II, Grade 2.

2.11 SEISMIC RESTRAINT CABLES

A. When required by design, seismic restraint cables shall be ½-inch diameter, seven-wire strand conforming to ASTM A416/A416M, prior to galvanizing.

B. The strand shall be galvanized in accordance with ASTM A475, or ASTM A603, with a minimum weight per unit of coated wire surface, Class A.

C. The minimum yield strength of the seven-wire strand shall be 270,000 psi.

2.12 TANK ACCESSORIES

A. A Type 316 stainless steel 36” square hinged flange access portals shall be provided in the tank side wall. The flange cover shall also be stainless steel and attached to a hinge to allow it to swing away from the opening when unbolted. The portal shall be designed to resist hydraulic loading without deflection.

B. Provide a 48” x 48” clear opening roof hatch on the dome of the tank. Exact location to be determine during shop drawing review. Hatch cover shall be fabricated from fiberglass with UV inhibitors.

C. Provide and a roof ventilator in the center of the dome roof fabricated from fiberglass with UV inhibitors.

D. Aluminum Accessories

1. An exterior ladder shall be provided for access to the top of the tank. Fabricate the ladder from 6061-T6 and 6063-T6 aluminum to conform to all applicable OSHA standards. Provide an aluminum safety cage and lockable security gate and a safety climbing device in accordance with applicable OSHA standards. Ladder to be located beside the roof hatch opening.
2. Provide handrail along the perimeter of the top of the tank to 20 feet either side of the hatch opening and 10 feet up the tank dome roof. Provide an opening in the handrail for access from the ladder. Handrail shall be fabricated in 20 ft typical sections from 6061-T6 aluminum and shall conform to all applicable OSHA standards.
3. Aluminum accessories shall be shop fabricated and fully welded. All welding shall be in accordance with American Welding Society (AWS) D1.2 to fuse materials without distortion of the material. Mechanical splices shall only be used at field splice locations.
4. Aluminum accessories shall have a "mill" finish.
5. Aluminum surfaces in contact with concrete shall be protected with a coat of bituminous paint.

E. Interior ladder shall be fabricated from fiberglass shall conform to all applicable OSHA standards. The ladder shall have a safety climbing device manufactured from Type 316 stainless steel as required to meet applicable OSHA standards.

F. Provide an exterior visual tank level indicator fabricated from fiberglass with UV inhibitors securely mounted to the side of the tank to prevent sagging and warping.

G. Provide a 4-inch diameter stainless steel flanged pipe sleeve penetration in the roof located a minimum of 10 feet from the interior wall of the tank for installation of an ultrasonic level transmitter. Sleeve shall have waterstop rings cast into the roof.

H. Furnish Type 316 stainless steel accessory hardware, conforming to ASTM F593.

2.13 COATINGS

A. Exterior Coatings

1. Surface Preparation: Remove all contaminants by power washing per SSPC-SP13/NACE 6. SSPC-SP1 is included in all SP Standards.

2. First Coat: Tnemec Series 156 Enviro-Crete 4.0 to 6.0 mils DFT

3. Second Coat: Tnemec Series 156 Enviro-Crete 4.0 to 6.0 mils DFT

B. Interior Coatings

1. All interior metal surfaces (including but not limited to pipes and pipe supports).

a. Surface Preparation: Solvent cleaning per SSPC-SP1. Ductile iron surfaces to receive abrasive blasting per NAPF 500-03-04. Carbon steel surfaces to receive abrasive blasting per SSPC SP-10 near white metal blast with a minimum 1.5 mil angular profile. All grinding and finishing of welds, edges, etc. shall be performed prior to solvent cleaning and abrasive blasting. Welds shall be prepared per NACE Standard SP0178 Designation “D” for all interior immersion surfaces.

b. Prime Coat: Apply Tnemec Series L140 / L140F Pota-Pox Plus at 4.0 - 6.0 mils DFT.

c. Finish Coat: Tnemec Series 22 or FC22 Epoxoline applied at 20.0 to 24.0 mils DFT.

PART 3 EXECUTION

3.1 EXAMINATION

A. All subgrade elevations shall be verified prior to starting tank construction.

B. All subgrade materials shall be tested for compaction prior to starting tank construction. Owner’s construction material testing (CMT) firm will perform testing. Contractor shall coordinate with the CMT firm when the subgrade is ready for testing.

C. Where below grade pipe is to be installed under the tank the backfill of the pipe shall be tested by the CMT firm.

3.2 INSTALLATION

A. Floor:

1. The subgrade shall be prepared by fine grading to ensure proper placement of reinforcing steel with proper bottom cover.

2. A 6-mil polyethylene vapor-barrier shall be placed after subgrade preparation has been completed.

3. Form and screed boards shall be of proper thickness and sufficiently braced to ensure that the floor is constructed within proper thickness tolerances.

4. Plate bolsters shall be used to support reinforcing steel supported directly on the subgrade to ensure positive control of placement of reinforcing steel.
5. The floor shall be vibratory screeded to effect consolidation of concrete and proper encasement of floor reinforcing steel.
6. The floor shall be water cured for a minimum of 7 days after casting.
7. The floor shall receive a light broom finish.

B. Core Wall:

1. The wall shall be constructed utilizing diaphragm and shotcrete with each conforming to the following:
   a. Diaphragm Erection:
      1) The diaphragm shall be protected against damage before, during, and after erection. Nail or other holes shall not be made in the diaphragm for erection except in the top 3 inches. Holes shall not be made in the diaphragm except for inserting wall pipes or sleeves, reinforcing steel, bolts, or other special appurtenances. Such penetrations shall be sealed with an epoxy sealant which complies with Section 2.10 Epoxy.
   b. Shotcrete:
      1) All shotcrete shall be applied by or under direct supervision of experienced nozzlemen certified by the American Concrete Institute (ACI) as outlined in ACI certification publication CP-60.
      2) Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding of the following layer.
      3) No shotcrete shall be applied to reinforcing steel or diaphragm that is encrusted with overspray.
      4) No less than ⅛" thick shotcrete shall separate reinforcing steel and prestressing wire.
      5) The diaphragm shall be encased and protected with no less than 1" of shotcrete in all locations.
      6) The interior shotcrete shall receive a light broom finish.
   c. Curing:
      1) Interior and exterior portions of the shotcrete wall shall be water cured for a minimum of 7 days or until prestressing is completed.

C. Epoxy Injection:

1. Epoxy injection shall be carried out from bottom to top of wall using a pressure pumping procedure.
2. Epoxy injection shall proceed only after the diaphragm has been fully encased, inside and outside, with shotcrete.

D. Dome:

1. All concrete shall be consolidated by means of a vibrator for proper encasement of reinforcing steel and welded wire fabric.

2. All surfaces at the joint between the wall and the dome shall be coated with bonding epoxy which complies with Section 2.10 Epoxy.
3. Plastic bolsters shall be used to support reinforcing steel and welded wire reinforcement to ensure positive control on placement of steel.
4. The exterior surface of the dome shall receive a light broom finish.
5. The dome shall be water cured for a minimum 7 days after casting or until dome band prestressing is completed.

E. Prestressing:

1. The initial tension in each wire shall be read and recorded to verify that the total aggregate force is no less than that required by the design. Averaging or estimating the force of the wire on the wall shall not be considered satisfactory evidence of correct placement of prestressing wires.
2. Placement of the prestressing steel wire shall be in a continuous and uniform helix of such pitch as to provide in each lineal foot of core wall height an initial force and unit compressive force equal to that shown on the design drawings. Splicing of the wire shall be permitted only when completing the application of a full coil of wire or when removing a defective section of wire.
3. Shotcrete shall be used to completely encase each individual wire and to protect it from corrosion. To facilitate this encasement, the clear space between adjacent wires is to be no less than one wire diameter.
4. Prestressing shall be accomplished by a machine capable of continuously inducing a uniform initial tension in the wire before it is positioned on the tank wall. Tension in the wire shall be generated by methods not dependent on cold working or re-drawing of the wire. In determining compliance with design requirements, the aggregate force of all tensioned wires per foot of wall shall be considered rather than the force per individual wire, and such aggregate force shall be no less than that required by the design and as shown on approved drawings.
5. The tank construction company shall supply equipment at the construction site to measure tension in the wire after it is positioned on the tank wall. The stress measuring equipment shall include: electronic direct reading stressometer accurate to within 2%, calibrated dynamometers and a test stand to verify the accuracy of the equipment.
6. After circumferential prestressing wires have been placed, they shall be protected by encasement in shotcrete. This encasement shall completely encapsulate each wire and permanently bond the wire to the tank wall.
7. When multiple layers of wire are required, shotcrete cover between layers shall be no less than ⅛" thick.

F. Covercoat:

1. After all circumferential prestressing wires have been placed, a shotcrete cover having a thickness of no less than 1" shall be placed over the prestressing wires.
2. Horizontal sections of the wall shall form true circles without flat areas, excessive bumps or hollows.
3. The covercoat shall receive a sliced trowel finish.

G. Wall Openings:

1. All wall pipes, sleeves and manholes passing through the wall shall be sealed to the diaphragm by epoxy injection.

H. Coatings:

1. The interior and exterior coatings of the tank (concrete surfaces and metallic surfaces) shall be coated by the tank construction company. The tank construction company shall have system responsibility for all coatings and shall not subcontract the work.
2. Exterior coating shall be applied a minimum of 14 days after final application of concrete or shotcrete. Interior coating shall be applied a minimum of 28 days after final application of concrete or shotcrete.
3. All application procedures for coatings shall meet the requirements of Section 2.13 and the manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Concrete and Shotcrete Testing:
   a. Compression Tests:
      1) Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to ensure continued compliance with these Specifications. At least one set of test specimens shall be made for each 50 yards of concrete/shotcrete placed. Each set of test specimens shall be a minimum of 5 cylinders.
      2) Compression test specimens for concrete/shotcrete shall conform to ASTM C172/C172M for sampling and ASTM C31/C31M for making and curing test cylinders. Test specimens shall be 6-inch diameter by 12-inch high or 4-inch diameter by 8-inch high cylinders.
      3) Compression test shall be performed in accordance with ASTM C39/C39M. Two test cylinders will be tested at 7 days and two at 28 days. The remaining cylinder will be held to verify test results, if needed.
   b. Air Content Tests (Concrete only)
      1) Air content tests shall conform to ASTM C231/C231M (Pressure Method for Air Content).
      2) Tests for air content shall be made prior to concrete placement and whenever compression test specimens are made.
   c. Slump Tests (Concrete only)
      1) Slump tests shall be made in accordance with ASTM C143/C143M.
      2) Slump tests shall be made whenever compression test specimens are made.
2. Hydrostatic Testing:
   a. The tank shall be tested for watertightness upon completion.
   b. The testing for watertightness shall be completed as follows:
      1) Fill the tank with water to the maximum water level and let it stand for a minimum of 24 hours.

2) Inspect the exterior of the tank wall and footing for damp spots. Damp spots shall be defined as spots where moisture can be picked up on a dry hand, the source of which is from inside the tank.

3) Leakage through the wall or wall-base joint shall be repaired and the tank shall be retested using the above procedure.

3.4 CLEANING AND DISINFECTION

A. The interior of the tank shall be cleaned to remove debris, construction items, and equipment prior to testing and disinfection.

B. The following disinfection procedure shall be used to disinfect storage tanks used for potable water:

1. Method 2 or 3 will be used for disinfection of the tank in accordance with ANSI/AWWA C652.

2. When Method 3 is used, the disinfection plan required by Section 1.3 A. shall address any compatibility issues with the form of chlorine used for disinfecting the storage tank with the type of disinfectant used in the normal production of the water used to fill the tank.

END OF SECTION

SECTION 33 31 00 SANITARY UTILITY

SEWERAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Manufacturers
2.2	Flowable Fill
2.3	Joints
2.4	PVC Pipe
2.5	HDPE Pipe
2.6	Ductile Iron Pipe
3.1	Bedding
3.2	Clean-Up
3.3	Connections
3.4	Cutting
3.5	Deflection Testing
3.6	Final Inspection Preceding Acceptance
3.7	Flowable Fill
3.8	General
3.9	Guarantee
3.10	Handling and Distribution
3.11	House Connections
3.12	Infiltration
3.13	Inspection Prior to Installation
3.14	Jointing
3.15	Low Pressure Air Testing
3.16	Safety Precautions
3.17	Storage
3.18	Television Inspection

A. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with Contract Documents.

1. Cast-in-Place Concrete (03 30 00).
2. Clearing and Grubbing (31 11 00).
3. Excavation and Fill (31 23 00).
4. Erosion and Sedimentation Controls (31 25 00).

5. Turf and Grasses (32 92 00).
6. Utility Pipe Jacking (33 05 23.16).
7. Roadway Construction (34 71 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.

1.3 WORK INCLUDED

A. The Contractor shall, under this item, furnish all the materials, perform all necessary excavation, and properly lay and test, at the locations indicated on the Drawings or directed, all pipe and all pipe specials of the sizes specified or indicated which are necessary for the proper completion of the Work.

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.

B. Piping submittal shall, at a minimum, show in detail the nominal pipe size, manufacturer name or trademark, and specification designation in accordance with ASTM/ANSI, of all piping and accessories to be used in construction.

C. The Contractor shall submit for approval, samples, specifications, and manufacturer's recommendations for making joints Contractor proposes to use. No pipe shall be laid until approval has been given by the Engineer and CUMMING UTILITIES.

D. Transition joints between sewer pipes of different materials shall be accomplished by the use of adapters made especially for that purpose. Shop drawings must be submitted and approved by the Engineer prior to the use of any adapter for this purpose.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following or an approved equal:

1. Polyvinyl Chloride (PVC) Pipe:
   a. Certainteed, Inc.
   b. Diamond Plastics, Inc.
   c. J-M Eagle
   d. Lamson Vylon Pipe

2. High Density Polyethylene (HDPE) Pipe:
   a. ADS
   b. ISCO Pipe
   c. J-M Eagle
3. Ductile Iron Pipe (DIP):
   a. American Cast Iron Pipe Company
   b. U.S. Pipe
   c. McWane Ductile
4. Accessories:
   a. A-LOK Products, Inc.
   b. Dresser Industries, Inc.
   c. Harrington Corporation (HARCO)

2.2 FLOWABLE FILL

A. General: It is the intent of these specifications to produce flowable, cementitious slurry by blending Class "C" fly ash and water. The slurry should be of consistency that is both flowable and self-leveling. It should also be such consistency that it can fill irregular shaped areas through gravity placement.

B. Materials:
   1. Fly Ash - Fly ash shall meet ASTM Specifications C-618. Section 3.2, when sampled and tested in accordance with Sections 4, 6, and 8, unless otherwise shown in the plans. Fly ash shall be of the Class "C" designation containing a minimum of 25% CaO (hydrated lime). Fly ash shall be obtained from a source approved by the Engineer. Fly ash test certification shall be provided to the Engineer.

C. Water - The water to be used in the slurry shall be clean, clear, and free of sewage, vegetable matter, oil, acid and alkali. Water known as potable may be used without testing. All other sources shall be tested in accordance with A.A.S.H.T.O. T-26 and approved by the Engineer.

2.3 JOINTS

A. The pipe shall be joined with an integral bell, bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell complete with a single rubber gasket. Joints shall meet the requirements of ASTM D3212.

B. All fittings shall utilize rubber gasket joints. Gaskets shall conform to ASTM F477.

C. Joint materials shall minimize infiltration, prevent entry of roots, resist disintegration, cracking, and breaking. Manufacturer's recommendations shall be followed implicitly in preparing pipe and making joints.

D. PVC sewer mains eight-inch (8”) and larger diameter shall NOT be joined by solvent cement with which the pipe surfaces are fused together.

E. Transitions between DIP and PVC:

1. Shall be accomplished by transition collar utilizing C900 x SDR Adapter, HARCO, or equal, meeting ASTM 1784 for material, ASTM D3212 for joints, ASTM F477 for gaskets, and ASTM D3034 and F1336 for fittings; *or* by utilizing a coated solid sleeve.
2. Transition joints will not be allowed within 36 feet of a manhole, when the end result would be 36 feet or less of PVC adjacent to a manhole.

2.4 POLYVINYL CHLORIDE PIPE (PVC)

A. PVC pipe for four inch (4") lateral connection and fittings pipe shall be Schedule 40.

B. PVC pipe may be used for six-inch (6") through twenty-four inch (24") diameter. PVC pipe and specials shall be of the bell and spigot type, meeting the minimum strength requirements of AWWA C900 DR 18. The pipe shall be made of PVC plastic having a cell classification of 12454B as defined in ASTM D1784. Fittings shall be made of PVC plastic meeting ASTM D3034 and F1336.

C. Pipe of four-inch (4") and six-inch (6") diameter shall not have laying lengths less than ten feet (10'). Pipe of eight-inch (8") and greater diameter shall have laying lengths no less than twelve feet (12'), and no greater than twenty feet (20'). The nominal laying length of wyes and tees shall be per ASTM D3034. Saddles are prohibited.

D. No old pipe or specials which have been previously used, nor pipe or specials which have been rejected shall be allowed in the Work, and they shall be removed from the project promptly and not again offered for inspection.

E. Each length of pipe shall be marked at intervals of five feet (5') or less on pipe barrel, in accordance with ASTM/ANSI to include manufacturer name or trademark, date of manufacture, nominal pipe size, class, hydrostatic test pressure, and ASTM/AWWA designation and be of color "green".

F. PVC pipe shall be joined with a rubber gasket or PVC ring which is designed to prevent inflow and exflow. Mechanical compression joints shall be molded plastic or similar material (with or without the use of rubber or elastic plastic compression rings) as described in ASTM C425 for polyvinyl chloride (slip joint). Precast joints or rubber push-type gaskets for compression joint sealing (ASTM D3312 or F477) are all acceptable. (PVC pipe shall not be joined by a solvent cement joint in which the pipe spigot wedges into the tapered socket and the surfaces fuse together).

G. In cases where pipe joints are required to be restrained the pipe shall utilize an internal restraint system suitable for C900/905 PVC pipe such as the CertainTeed Certa-Lok C900/RJ Restrained Joint System, Diamond Plastics Diamond Lok-21, JM Eagle Eagle Loc900, RieberLOK, or approved equal.

H. Where specified, indicated on the Drawings, or directed by the Engineer, Class 50 Ductile Iron Pipe and specials shall be substituted in lieu of PVC pipe. Ductile Iron Pipe shall meet the requirements of Paragraph 2.6 Ductile Iron Pipe (DIP).

2.5 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

A. HDPE sewer pipe shall be dual wall, corrugated pipe that has a smooth interior and an annular exterior corrugation; made of high density polyethylene resin that meets or

exceeds ASTM D-3350 requirements, manufactured and tested in accordance with ASTM F-2648.

B. HDPE sewer pipe shall be joined with watertight, bell and spigot joints with gaskets meeting the requirements of ASTM F-477, and joints meeting watertight performance requirements of ASTM D-3212.

C. HDPE sewer pipe shall have laying lengths of twenty feet (20').

D. Fittings shall be in accordance with ASTM F-2648 and be watertight meeting the requirements of ASTM D-3213. Manufacturer shall supply joint lubricant for use on the gaskets during assembly.

E. Where indicated on the Drawings, or directed by CUMMING UTILITIES, Class 50 Ductile Iron Pipe and specials shall be substituted in lieu of HDPE pipe. Ductile Iron Pipe shall meet the requirements of Paragraph 2.6 Ductile Iron Pipe (DIP).

2.6 DUCTILE IRON PIPE (DIP)

A. Where specified, indicated on the Drawings, or directed by the Engineer, DIP gravity sewerage pipe and fittings shall conform to the requirements of ANSI/ASTM A746, Ductile Iron Gravity Sewer Pipe. DIP shall be cast, clean, cement-lined, asphalt coated, tested, and certified at a single manufacturing facility.

B. DIP thickness class shall be as indicated on the Drawings.

C. Nominal laying lengths shall be eighteen feet (18') or twenty feet (20') for pipe diameters specified.

D. DIP pipe shall be marked in accordance with ASTM/ANSI designations at intervals of five feet (5') or less on pipe barrel. As a minimum, pipe marking shall include manufacturer name or trademark, nominal pipe size, specification designation, and date of manufacture.

E. PUSH-ON JOINT PIPE AND FITTINGS

1. Push-On Ductile Iron Pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51.

2. Push-On Ductile Iron Fittings shall be manufactured with body thickness and radius of curvature conforming to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53.

3. At a *minimum*, fittings four (4) inch through twenty (20) inch shall be rated for 350 psi, and twenty-four (24) inch through sixty-four (64) inch shall be rated for 250 psi.

4. Joint deflection shall be five degrees (5°) for four-inch (4") through twelve- inch (12"); four degrees (4°) for fourteen-inch (14"); three degrees (3°) for sixteen-inch (16") through twenty-four-inch (24"); and two and one-half degrees (2½°) for thirty-inch (30").

F. MECHANICAL JOINT PIPE AND FITTINGS

1. Mechanical Joint Ductile Iron Pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51.

2. Mechanical Joint Ductile Iron Fittings shall be manufactured with body thickness, laying length, and fittings conforming ANSI/AWWA Standard C110/A21.10 or ANSI/AWWA C153/A21.53 and joints in accordance with ANSI/AWWA Standard C111/A21.11.

3. Mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts of high strength, heat treated, cast iron containing 0.50 percent copper or high strength low-alloy steel having a minimum yield point strength of 40,000 psi and an ultimate tensile strength of 70,000 psi.
4. Gasket, bolts, and nuts shall conform to ANSI A21.11. Gaskets shall be of neoprene or rubber, unless specified otherwise, of such quality that they will not be damaged by the liquid or gases with which they come in contact.
5. Glands shall be of high strength cast iron.

G. GASKETS

1. PUSH-ON & MECHANICAL - Sufficient lubricant shall be furnished with each order of pipe to provide a thin coating on each spigot end. Lubricant shall have no deleterious effect on the rubber gasket. Lubricant shall be of such consistency that it can be easily applied to the pipe in either hot or cold weather and shall adhere to either wet or dry pipe. **Only lubricant furnished with the pipe by the pipe manufacturer shall be used**.
2. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11, and shall be styrene butadiene rubber (SBR).

H. EXTERIOR COATING

1. Where the pipe is located within ten feet (10') of a utility line that has cathodic protection that can cause a deleterious effect on the piping system, the exterior of ductile iron pipe shall be base-coated with a layer of arc- sprayed zinc per ISO 8179. The mass of the zinc applied shall be 200 g/m^2 (0.6554 oz/ft^2) of pipe surface area. A finishing layer of asphaltic topcoat shall be applied to the zinc. The mean, dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils. The coating system shall conform in every respect to ISO 8179-1 "*Ductile Iron Pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer, Second Edition 2004-06-01*."
2. Where soils with electrical or stray currents are encountered, polywrap may be added to the zinc-coated pipe for additional corrosion protection. Polyethylene tube encasement shall be prefabricated, manufactured and supplied in accordance with ANSI/AWWA C105/A21.5, "*Polyethylene Encasement for Ductile Iron Pipe Systems.*" The wrap shall be overlapped one foot in each direction at joints, and secured in place around the pipe, and any wrap at tap locations shall be polyethylene taped tightly to prevent the entrance of foreign matter prior to tapping and inspected for any needed repairs following the tap.

I. LININGS

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

PART 3 - EXECUTION

3.1 BEDDING

A. For gravity sanitary sewer flow in PVC pipe material, as a minimum, Class 'B' Bedding shall be used. Additional bedding material may be required dependent upon laying conditions, or as directed by the Engineer.

B. For gravity sanitary sewer flow in DIP pipe material, as a minimum, Class 'C' Bedding shall be used. Additional bedding material may be required dependent upon laying conditions, or as directed by the Engineer.

C. For laying pipe in rock trench, the trench shall be made to conform to the general dimensions required, and the trench bottom shall be undercut to allow a minimum of six inches (6") of bedding material to be placed and compacted to establish the required sub-grade elevation. Additional bedding may be required as determined by bedding class required dependent upon pipe material, laying conditions, or direction of the Engineer. Sides and bottom of sewers shall be supported by compacting materials in place, so as to ensure an even bearing surface for the pipe. Particular care shall be taken that pipes are not permitted to rest upon or against solid or projecting portions of rock.

D. No pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. The supporting of pipe on wood blocks, loose brick, etc., shall NOT be permitted. Defects due to settlement shall be corrected by the Contractor at no expense to CUMMING UTILITIES.

E. Take care to avoid contact between the pipe and mechanical compaction equipment so as not to damage the pipe. Do not use compaction equipment directly over the pipe until sufficient Initial Backfill has been placed to assure that such equipment shall not damage or disturb the pipe.

3.2 CLEAN-UP

A. A thorough cleanup shall be made before final acceptance and final payment is made. All excess rock shall be removed, private and public property shall be restored to original condition, and all excess pipe and fittings shall be removed.

3.3 CONNECTIONS

A. When making connection to existing sewers, the Contractor shall remove all bulkheads and shall make proper connections to structures and sewers as specified, indicated on the Drawings, or directed by the Engineer or CUMMING UTILITIES.

Contractor shall make all necessary pipeline and sewer connections where required. No extra payment shall be made for this Work, but the entire cost of same shall be considered as having been included in the Unit Prices Bid.

B. Where pipe is connected to a concrete or masonry structure which has no existing stub out or cored hole, Contractor shall make such connection *only* with a core into the structure, and provide a flexible manhole boot.

3.4 CUTTING

A. Whenever a pipe requires cutting, the pipe shall be cut in a satisfactory manner so as to leave a smooth end at right angles to the axis of the pipe. The end shall then be beveled in

accordance with manufacturer's recommendations for field beveling.

3.5 DEFLECTION TESTING

A. Deflection tests shall be required, when in the opinion of CUMMING UTILITIES CCTV Inspection, there is reason to suspect excessive deflections; and said tests shall be performed no sooner than thirty (30) days following completion of backfill unless otherwise approved. Deflection tests shall be performed by CUMMING UTILITIES with the CUMMING UTILITIES Inspector present. Maximum ring deflection of the pipe, under load, shall be limited to five percent (5%) of the inside pipe diameter.

B. All pipe failing to maintain the minimum deflection diameter shall be considered improperly installed and shall be re-laid or replaced by the Contractor.

3.6 FINAL INSPECTION PRECEDING ACCEPTANCE

A. Final inspection may include a visual inspection of each section of sewer by looking from manhole to manhole with the aid of reflected sunlight or an electric light. Such light used for inspection shall be plainly visible from manhole to manhole. Light reflected along the pipe walls from manhole to manhole shall not be considered as plainly visible light and shall be reason for rejection of the section of sewer as not being laid true to line and grade. The pipe shall be true to both line and grade; shall show no leaks, shall be free from cracks and protruding joint materials and contain no deposits of sand, dirt, or other materials. All finished Work shall be neat in appearance of first class workmanship.

3.7 FLOWABLE FILL

A. Equipment:

1. The equipment used by the Contractor shall be capable of properly blending the materials into a homogeneous mixture, suitable for the intended use and complying with all specifications included herein.

2. Equipment shall be capable of continuous mixing. Elapsed time, from the time materials are introduced into the mixing unit, until they are gravity fed from the mixer, shall not exceed (1) minute.

3. Equipment that requires the use of chemical retarders or other additives is not acceptable without written permission of the Engineer. All equipment shall be approved by the Engineer prior to starting work.

B. Fly Ash Storage and Delivery:

1. Fly ash shall be stored and handled in closed, waterproof containers until being introduced into the mixing equipment.

2. If fly ash is furnished in trucks, each truck shall have the weight of fly ash certified on public scales.

3. Reclaimed fly ash or fly ash that has been exposed to moisture shall be rejected.

C. Construction Methods: Bulkheads shall be built at both ends of the structure intended for abandonment or casing pipe. Placement of the slurry should start at a point nearest the downstream bulkhead; placement should be through a manhole or inlet. A vent hole should be used to allow for air to escape. Placement shall continue until material is expelled

through the vent hole and slurry backs ups through the manhole or inlet. Once this happens, the equipment is moved upstream to the nearest manhole or inlet, and the procedure is repeated until the structure is completely filled.

D. Sampling and Testing:

1. Samples shall be taken at the rate of one (1) per 8-hour shift, unless otherwise directed by the Engineer. Cylinders shall be cast and field cured at the worksite for a minimum of six (6) hours before being taken to the lab. Compressive strength shall be a minimum 100-psi at 28 days.

2. Prior to starting the Work and no later than 48 hours before placement, the Contractor shall submit to the Engineer in writing both a method statement and mix design.

E. If required by the Engineer, the flowability shall be checked by the use of the U.S. Army Corps of Engineers "Flow Cone Test Method". Maximum efflux time is 10-16 seconds; this is an optional requirement. The Contractor shall hire a reputable testing lab acceptable to the Engineer to perform the above mentioned tests.

3.8 GENERAL

A. All pipe shall be thoroughly cleaned before being laid, and shall be kept clean until acceptance of the completed Work. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipes shall be used.

B. All trenches shall be kept free from water when pipe laying is in progress, and no water shall be allowed to rise within twelve inches (12") of the bottom of the pipe until jointing is completed.

C. Pipe and specials shall be laid accurately to required lines and grades and shall be uniformly supported along their entire length. Bottoms of excavations shall be properly trimmed and bell holes dug to properly support joints. Size of bell holes shall be kept to a minimum, but shall be large enough to permit the proper making of joints.

D. The open end of uncompleted pipelines shall be provided with a temporary stopper carefully fitted so as to keep dirt and other substances from entering. This stopper shall be maintained in position at all times when laying is not actually in progress.

3.9 WARRANTY

A. The Contractor shall warranty for a period of twelve (12) months from the date of Final Completion all lines, appurtenances, trenches, and other disturbed surfaces.

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 shall be held responsible for the cost of all repairs, including pavement replacement.

3.10 HANDLING AND DISTRIBUTION

A. Pipe shall be carefully transported, stored, and handled to prevent damage to the pipe or bell. Damaged pipe or bells shall be cause for rejection of the pipe. Pipe shall be stored in such manner as to keep the interior free of dirt or other foreign matter.

B. Stringing out of pipe more than two (2) days in advance of installation shall not be permitted.

3.11 SERVICE CONNECTIONS

A. Provision shall be made in sewer mains for Service Connections as specified, indicated on the Drawings, or directed by the Engineer or CUMMING UTILITIES. Service Connections for each building sewer lateral shall be made by installing in the sewer main, at forty-five degrees (45°) above the horizontal axis of the sewer main, a 'Wye' (for PVC pipe), or a 'Tee' (for Ductile Iron Pipe). All Service Connections shall be six-inch (6") diameter.

B. Service Connections out of manholes, as indicated on the Drawings or as directed by the Engineer or CUMMING UTILITIES, shall extend from the manhole a minimum of ten feet (10'). All stub outs shall be stopped with mechanical plug, joints equal to that specified, and properly installed and braced to prevent leakage during periods of testing. All pipes laid out of manholes shall connect to the manhole by utilizing a cored hole with a flexible manhole boot.

C. Service Connections shall be properly stopped with a mechanical plug and marked appropriately on the ground surface.

D. For sewer mains exceeding twelve feet (12') in depth, Contractor shall use a Deep House Connection. This connection shall utilize a DIP 'Tee' on the main line, DIP service line placed vertically, and topped by a DIP 'Tee' and plug. Connection assembly shall be such that the elevation of the upper 'Tee' shall not be less than five feet (5') below finish grade, and at such elevation as to properly receive the building sewer lateral. Allow a minimum of one percent (1.0%) slope from building sewer lateral elevation to the Service Connection elevation.

E. When Service Connections are so located that those on opposite sides of the street come to the same point in the sewer, the Contractor must install a separate 'Tee' for each Service Connection.

F. In general, it is the intent to locate building sewer laterals during construction.

G. Service Connections shall extend from the main line to five feet (5') outside of road right-of-way, easement line, or as indicated on the Drawings or directed by CUMMING UTILITIES.

H. Replace or restore lawns and landscaped areas per requirements of Specification Section 32 92 00 Turfs and Grasses.

I. Where indicated on the Drawings, or as directed by the Engineer, Class 50 ductile iron pipe and specials shall be substituted in lieu of PVC Service Connections. Ductile Iron Pipe and specials shall meet the requirements of this specification section, Paragraph 2.6 Ductile Iron Pipe (DIP).

3.12 INFILTRATION

A. On newly installed sewers sixteen-inch (16) or less diameter, no infiltration or leaks shall be allowed. Any infiltration flowing at the low point of a project must be eliminated prior to approval.

B. On large diameter mains (greater than sixteen-inch (16") diameter), the allowable infiltration shall not exceed 75 gallons per day/inch diameter/mile. Visible or known leaks shall not be allowed regardless of total infiltration.

3.13 INSPECTION PRIOR TO INSTALLATION

A. Pipe shall be inspected and tested at the mill or warehouse by an approved, independent testing laboratory to determine conformity with requirements of ASTM Standards. Signed and dated certificates stating results of inspection and tests shall accompany each shipment and shall be a prerequisite to acceptance of the shipment on the Work by the Engineer.

B. Prior to lowering pipe and specials into the trench, a field inspection may be made by the Engineer.

3.14 JOINTING

A. When pipes are ready for jointing, bell interior and spigot surface shall be cleaned of all dirt and foreign matter, coated with manufacturer's approved lubricant, and pipes shoved home. Care shall be exercised after laying to

prevent deflection or separation of the joint just made. All joints shall be made in the trench, and only one (1) joint shall be made at a time.

B. All pipe ten-inch (10") diameter and smaller shall be joined using a pry bar and block. On pipe larger than ten-inch (10") diameter, mechanical assistance may be necessary.

C. When the joint is completed, the sewer shall have a smooth, unobstructed invert, and the pipe shall be true to grade and alignment. If the invert protrudes above the invert of adjacent pipe it shall be removed and replaced.

D. After the pipe has been properly embedded and joints made, Initial Backfill materials shall be carefully tamped on each side of the pipe between the walls of the excavation and the pipe before Final Backfill is performed as specified under Specification Section 31 23 00 Excavation and Fill.

E. Great care shall be used to secure water tightness and to prevent damage to or disturbing of joints during backfilling, or at any other time after the pipes have been laid and the joints have been made. There shall be no walking on or working over the pipe except as may be necessary in tamping, until there is cover no less than one foot (1') in depth over the top of the pipe.

F. All joints showing leakage shall be uncovered and the joints remade at Contractor's expense.

G. Laying Pipe in Freezing Weather: No pipe shall be laid upon a foundation in which frost exists, nor when the Engineer deems that there is a danger of the formation of ice or the penetration of frost at the bottom of the excavation.

3.15 LOW PRESSURE AIR TESTING

A. After completing backfill of a sewer line section, conduct a low pressure air test of all pipe constructed, using methods and devices acceptable to CUMMING UTILITIES. Prior to testing for acceptance, the pipe should be cleaned by passing through the pipe a full gauge squeegee. It shall be the responsibility of the Contractor to have the pipe clean. Perform such test using the following general procedures:

1. Temporarily plug line segment between two (2) manholes using plugs having airtight fittings through which low pressure air can be introduced into the pipe segment being tested.

2. Introduce low pressure air into the test pipe segment until the internal air pressure reaches 4.5 psig above water pressure, if any.
   Where high ground water is known to exist, the height in feet of ground water above the invert of the sewer shall be divided by 2.31 to establish the pounds of pressure that shall be added to the internal air pressure used for the test.

3. Wait at least two (2) minutes for air temperature in the test segment to stabilize while internal air pressure remains a minimum of 3.5 psig above ground water pressure.

4. Bleed internal air pressure to exactly 3.5 psig above ground water pressure.

5. Accurately determine the elapsed time for internal pressure to drop to 3.0 psig above ground water pressure.

6. The air test is acceptable if elapsed time is no less than shown by the following table:

PIPE DIAMETER	ELAPSED TIME Minutes/100 feet 6-Inch .7
8-Inch	1.2
10-Inch	1.5
12-Inch	1.8
15-Inch	2.1
18-Inch	2.4
24-Inch	2.7

B. Air test shall not be required on pipe larger than 18 inches in diameter.

C. Permanently correct excessive leakage determined by air testing, and repeat operations until Engineer witnesses a successful test on each line segment in accordance with ASTM F1417. If the pipe installation fails to meet these requirements, the Contractor shall determine at his/her own expense, the source or sources of leakage, and he/she shall repair (if the extent and type of repairs proposed by the Contractor is approved by CUMMING UTILITIES) or replace all defective materials or workmanship. Final acceptance of each section or run of sewer tested shall not be issued until leakage has been reduced to rates not exceeding the maximum specified. The Contractor shall furnish all facilities and personnel for conducting tests. All wyes, tees, or end of side sewer stubs shall be plugged with flexible joint caps, or acceptable alternate, securely fastened to withstand the internal test pressures. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

3.16 SAFETY PRECAUTIONS

A. The low pressure air test may be dangerous to personnel if a line is over pressured or plugs are installed improperly. It is extremely important that the plugs be installed so as to prevent their sudden expulsion. Observe the following safety precautions:

1. No one shall be allowed in the manholes during testing.

2. Install all plugs securely.

3. When lines are to be tested, it may be necessary that the plugs be braced as an added safety factor.

4. Do not over pressurize the lines.

B. Final acceptance of each section or run of sewer tested shall not be issued until leakage has been reduced to rates not exceeding the maximum specified herein as permissible.

C. The required measurements for leakage shall be made by the Engineer, but the Contractor shall furnish all labor, materials, and equipment; including hose, weirs, and water supply, as may be necessary in making test. No direct or separate payment shall be made for these tests but the cost thereof shall be included in the Unit Prices Bid for pipe installation.

3.17 STORAGE

A. Store pipe on a flat surface so the barrel is evenly supported. Do not stack higher than 4 feet. For extended storage, PVC pipe must be covered with an opaque material to shield it from the sun's rays. Bells must be stacked in opposing directions on alternate rows so they are not supporting the full load.

3.18 TELEVISION INSPECTION

A. During the progress of construction and upon completion of the same, CUMMING UTILITIES shall inspect, by closed circuit television, all sewers inclusive for leakage, faulty joints, or faulty pipe. The Contractor shall not remove temporary access roads, bridges, and creek crossings until authorized to do so by the Engineer.

END OF SECTION 33 31 00

SECTION 33 33 00

DUCTILE IRON PIPE AND FITTINGS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. This section specifies ductile iron pipe, ductile fittings and gaskets.
2. Refer to Section 33 30 00 for additional requirements.

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.

1. 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.
2. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
3. 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).
4. 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.
5. 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.

PART 3 Reference	**PART 4**Title
PART 5ANSI B1.1	**PART 6**Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
PART 7ANSI B16.1	**PART 8**Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
PART 9ANSI B16.5	**PART 10**Pipe Flanges and Flanged Fittings
PART 11ASTM A 193	**PART 12**High Tensile Alloy and Stainless Steel Bolts
PART 13ASTM A 194	**PART 14**Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
PART 15ASTM A242	**PART 16**Standard Specification for High-Strength Low-Alloy Structural Steel
PART 17ASTM A307	**PART 18**Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
PART 19ASTM A563	**PART 20**Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
PART 21ASTM A716	**PART 22**Ductile-Iron Culvert Pipe
PART 23ASTM A746	**PART 24**Standard Specification for Ductile Iron Gravity Sewer Pipe
PART 25ASTM B633	**PART 26**Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
PART 27ASTM C150	**PART 28**Portland Cement
PART 29AWWA C104 (ANSI A21.4)	**PART 30**Cement-Mortar Lining for Ductile- Iron and Gray-Iron Pipe and Fittings for Water
PART 31AWWA C105 (ANSI A21.5)	**PART 32**American National Standard for Polyethylene Encasement For Ductile-Iron Pipe Systems
PART 33AWWA C110 (ANSI A21.10)	**PART 34**Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
PART 35AWWA C111 (ANSI A21.11)	**PART 36**Rubber-Gasket Joints for Ductile- Iron and Gray-Iron Pressure Pipe and Fittings
PART 37AWWA C115 (ANSI A21.15)	**PART 38**Flanged Ductile-Iron and Gray-Iron Pipe With Threaded Flanges

Reference	Title
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
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.
   a. Check marks shall denote full compliance with a paragraph as a whole.
   b. 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.
   c. The Construction Manage shall be the final authority for determining acceptability of requested deviations.
   d. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
2. 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.

B. The following information shall be submitted by pipe and fitting suppliers

1. Name of the pipe manufacturer and a list of the piping and quantities to be provided by manufacturer.

2. Name(s) of fitting manufacturer(s) and lists of fittings and quantities to be provided by manufacturer.
3. Pipe and fitting product data indicating conformance with this Specification, applicable standards, and warranty provisions, including written documentation regarding any intended variance from this specification and applicable standards.
4. At the time of shipment, the supplier shall provide certified documentation of pipe and fitting conformance with this Specification and applicable pipe and fitting standards specified herein.

PART 2 – PRODUCTS

2.1 GENERAL

A. Pipe design, materials and manufacture shall comply with the following documents:

PART 51 Item	**PART 52**Document
PART 53 Thickness design	**PART 54**AWWA C150
PART 55 Manufacturing requirements	**PART 56**
• Water or other liquid	**PART 57**AWWA C151
PART 58 Gravity sewer pipe	**PART 59**ASTM A746
PART 60 Joints	**PART 61**
• Rubber gasket	**PART 62**AWWA C111
• Threaded flange	**PART 63**AWWA C115
PART 64 Fittings	**PART 65**
• Water or other liquid	**PART 66**AWWA C110/AWWA C153
PART 67 Cement mortar lining	**PART 68**AWWA C104

B. All ductile iron pipe shall be marked in accordance with AWWA C151 and ductile iron fittings shall be marked in accordance with AWWA C110.

C. Acceptable Manufacturers
1. American Cast Iron Company
2. U.S. Pipe
3. Or approved equal

2.2 PIPE

D. All pipe shall be Class 50 (thickness class) for 16-inch and smaller, and Class 51 for 18-inch and larger, unless otherwise specified or shown on the Drawings.

E. Flanged pipe minimum wall thickness shall be equal to Special Class 53. Flanges shall be furnished by the pipe manufacturer.

F. All pipes shall have a minimum pressure rating as indicated in the following table and corresponding minimum wall thickness, unless otherwise specified or shown on the Drawings:

PART 69 Diameter	**PART 70**Minimum Pressure Class
PART 714" through 20"	**PART 72**350
PART 7324" and greater	**PART 74**300

G. Unless otherwise specified, pipe shall have nominal laying lengths of 18 or 20 feet.

H. All pipe shall be manufactured in the United States of America.

I. Certificates of conformance with the foregoing Specifications shall be furnished with each lot of pipe supplied.

2.3 GASKETS

J. Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene.

1. 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.

K. Gaskets for flanges shall be the full face type.

1. 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.

L. Gaskets shall, in addition, comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

M. Sufficient lubricant shall be furnished with each order of pipe to provide a thin coating on both the gasket and the spigot-end of the pipe.

1. Lubricant shall be NSF 61 approved and shall have no deleterious effect on the rubber gasket.
2. Lubricant shall be of such consistency that it can be easily applied to the pipe in either hot or cold weather, and shall satisfactorily adhere to either wet or dry pipe.
3. ONLY LUBRICANT FURNISHED WITH THE PIPE BY THE PIPE MANUFACTURER SHALL BE USED.

2.4 FITTINGS

N. Unless otherwise specified, fittings shall conform to AWWA C110 with a minimum rated working pressure of 250 psi.

O. Ends shall be flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified.

P. The AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings unless otherwise specified.

Q. In general, use flanged fittings with long radius elbows except where space limitations prohibit use of same.

R. Design of special flanged fittings, including wall castings, shall conform to dimensions and details as directed, indicated, or noted on the approved drawings.

S. Fittings shall be cement lined in accordance with AWWA C104 and shall be furnished with a bituminous outside coating.

T. In lieu of cement lining and bituminous coating, fittings may be provided with a fusion bonded coating and lining meeting the requirements of AWWA C116.

U. Galvanized pipe fittings and PVC pipe fittings shall not be used as any part of the Fulton County Sewer System, nor shall it be used to join any appurtenances to the System.

2.5 JOINTS

A. Unrestrained Joints:

1. Push-On Joints:
    a. Unrestrained joints, where specified, shall be the rubber ring compression, push-on type joint suitable for buried services.
    b. Acceptable unrestrained joints shall be:
    1) Fastite Joint as manufactured by American Cast Iron Pipe Company
    2) Tyton Joint as manufactured by U.S. Pipe
    3) Or approved equal.
    c. This joint is not permitted on fittings or specials, unless otherwise specified.
    d. Unless otherwise specified, joints shall have a maximum allowable deflection up to 5 degrees at specified pressures.
    e. Gaskets shall comply with Paragraph 2.03.
    f. Joint assembly and field cut joints shall be made in strict conformance with AWWA C600 and manufacturer's recommendations.
2. Mechanical Joints:

a. Where specified, mechanical joints for above or below ground services shall meet the requirements of ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.11/C111.
b. Mechanical joint glands shall be ductile iron.
c. Gaskets and bolts and nuts shall comply with paragraphs 2.03 and 2.05D, respectively.

B. Restrained Joints:
1. General:
a. Unless otherwise specified, restrained joints shall be flanged or grooved end for exposed service and restrained push-on for buried services.
b. Restrained joint pipe (RJP) on supports shall have bolted joints and shall be specifically designed for clear spans of at least 36 feet.
2. Push-On Joints:
a. Restrained push-on joints shall be as specified in paragraph 2.05A, modified for restraint.
b. Acceptable restrained push on Joints
1) Flex-Ring or Lok-Ring Joint as manufactured by American Cast Iron Pipe Company,
2) TR Flex or HP Lok Joint as manufactured by US Pipe
3) Clow “SUPER-LOCK”
4) Griffin “SNAP-LOK”
5) Or approved equal.
c. Restraining gasket joints shall be assembled with American Fast-Grip gaskets or US Pipe FIELD LOK gaskets and may be used for pipe 12-Inches in diameter or less.
d. Restrained joints shall be capable of being deflected after full assembly.
e. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations.
f. No field welding for manufactured restrained joint pipe assembly will be permitted.
g. No field cuts of restrained pipe are permitted without prior approval of the Owner.
h. Where field cutting of restrained joint pipe is required, the joint shall be assembled with American Field Flex-Rings or US Pipe TR FLEX GRIPPER Rings.
3. Flange Joints:
a. 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.
b. Flanges shall be adequate for 250 psi working pressure.

c. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges.
d. Gaskets shall be as specified in Paragraph 2.03.

4. Thrust collars shall be weldedon ductile iron body type or split retainer gland type, as shown on the Drawings or directed by the Owner, designed to withstand thrust due to 300 psi internal pressure on a dead end.
5. Anchorage:
    a. All valves, caps, tees, bends deflecting 11 ¼ degrees or more and other fittings shall have two forms of restraint as one of the following:
        1) Manufactured restrained joint plus concrete blocking (3,000 psi concrete thrust block sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)
        2) Manufactured restrained joint plus rodding to concrete thrust collar (3,000 psi concrete collar and tie rods sized to withstand line pressures of 300 psi and soil bearing pressures of 2,000 psf)
6. Mechanical Joints:
    a. Where specified, restrained mechanical joints shall be the positive restraint type.
    b. Retainer glands on a mechanical joint may be used as a restrained joint only where retainer glands are specifically shown on the drawings, where specifically specified or where specifically identified and allowed by the Owner.
        1) Retainer glands shall be Megalug Series 1100, as manufactured by EBAA Iron, or Uni-Flange Series 1400, as manufactured by Ford Meter Box Company.
    c. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.

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.
2. Each joint shall be provided with a retainer lock to prevent rotation after assembly.
3. Joints shall be the Flex-Lok Joint as manufactured by American Cast Iron Pipe Company, USIflex as manufactured by U.S. Pipe, or equal.

D. Bolts and Nuts:
1. Provide the necessary bolts for connections. All bolts and nuts shall be threaded in accordance with ANSI B1.1, Coarse Thread Series, Class 2A external and 2B internal fit. All bolts and nuts shall be made in the U.S.A.
2. Bolts and nuts for mechanical joints shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown in AWWA C111/ANSI A21.11.

3. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolt length and diameter shall conform to ANSI/AWWA C115 for Class 125 flanges shown in ANSI/ASME B16.1.
4. Bolts for exposed service shall be zinc plated, cold pressed, steel machine bolts conforming to ASTM A 307, Grade B. Nuts for exposed service shall be zinc plated, heavy hex conforming to ASTM A 563. Zinc plating shall conform to ASTM B 633, Type II.
5. Bolts for submerged service shall be stainless steel machine bolts conforming to ASTM A 193, Grade B8M. Nuts shall be heavy hex, stainless steel conforming to ASTM A 194, Grade 8M.
6. Corrosion-resistant bolts and nuts for use with ductile iron joints shall be Type 316 stainless steel

E. Tapping Saddles: Tapping saddles are not allowed.

F. Pipe outlets shall be welded-on ductile iron pipe and shall be provided in lieu of tees or saddles on pipes with a diameter greater than or equal to 24-inches.

1. Outlets shall be plain end, push-on, mechanical or flanged joint, and shall meet the joint requirements stated in this Specification.
2. All welding, fabrication and outlet hole drilling shall be performed by the manufacturer of the parent pipe.
3. Outlets shall be free of burrs. Sizes shall be as indicated on the Drawings.
4. The outlets and parent pipe shall be minimum Class 53 ductile iron pipe for parent pipe 54-inches and smaller.
5. For pipe larger than 54-inches, parent pipe shall be Pressure Class 350.
6. Each welded outlet shall be rated for 250 psi working pressure and hydrostatically tested at 500 psi.
7. The maximum outlet diameters shall not exceed those listed in the table below:

Parent Pipe Diameter, Inches	Maximum Outlet Diameter, Inches
24	16
30	20
36	24
42	30
Parent Pipe Diameter, Inches	Maximum Outlet Diameter, Inches
48	30
54	30
60	30
64	30

2.6 PIPE COATING

A. The exterior of ductile iron pipe and fittings shall be coated with a layer of arc-sprayed zinc per ISO 8179.
   1. The mass of the zinc applied shall be 200 g/m^2 of pipe surface area.
   2. A finishing layer of bituminous topcoat as specified in AWWA C151 shall be applied to pipe and fitting over the zinc.
   3. The coating system shall conform in every respect to ISO 8179-1 “Ductile iron pipes – External zinc-based coating - Part 1: Metallic zinc with finishing layer. Second edition 2004- 06-01.”

B. Where 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, the piping system shall be wrapped with polyethylene in accordance with the manufacturers recommendations to a minimum distance of 20 lineal feet beyond such conditions.
   1. All elements of the piping system shall be wrapped entirely in polyethylene tubbing and secured with polyethylene tape to completely prevent the entrance of foreign matter.
   2. Such encasement shall be carried out in accordance with AWWA/ANSI 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.
   3. Pipe and fittings shall be lined with 40 mil dry film thickness of Protecto 401 Ceramic Epoxy by Induron or equivalent. A seal coat over the ceramic lining is not required.

2.8 PRODUCT DATA

A. The following information shall be provided in accordance with Section 01 33 23:
   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

3.1INSTALLATION

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. Coatings and linings shall be inspected for damage during installation, and damage shall be repaired according to the coating manufacturer's recommendations.

B. Insulating Sections
1. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided.

C. 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. Gravity Sewer:
1. Infiltration and exfiltration tests as specified in Section 33 30 00.

B. Force Main
1. Hydrostatic pressure and leakage in accordance with Section 4 of AWWA C600 except that test pressures shall be as listed in Section 33 30 00 and no leakage will be allowed.

C. The Contractor shall conduct the tests in the presence of the Owner.

3.3 GUARANTEE

A. Material Warranty:
1. A written guarantee of 20 years submitted to the County for the specific project shall be provided by the Manufacturer against any defects of the pipe and fittings material.

2. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the supplier of warranty responsibility for the full warranty term.

B. Workmanship Warranty

1. The Contractor shall guarantee the Work is free from defects in material and workmanship for a period of 10 years from the final acceptance.

2. The warranty shall cover the costs to repair or replace items including, but not be limited to, all gravity sewers, force mains, manholes, appurtenances, trenches, roadways, landscaping, other areas disturbed by the construction of the project and freight to project site, should these items have any defects in material or workmanship.

3. A successful pressure test or pressure leak test prior to the expiration of the warranty period shall not relieve the installer of warranty responsibility for the full warranty term.

C. Deficiencies related to material and workmanship shall be repairedby Contractor to the satisfaction of the Owner.

D. No bell clamps or wrap around corsets are allowed as a means of repair on new pipelines.

E. The Contractor shall be responsible to cover all costs, including materials and labor, associated with these repairs.

F. If required, Contractor and pipe manufacturer representatives may participate in inspections to determine such deficiencies.

G. If repairs are made, the Contractor/Manufacturer shall warrant the repaired work for the periods as specified above for material and workmanship in addition to the original warranty period required by the Contract.

H. The Contractor shall be responsible for repairs to any trench settlements caused by leaking pipe, fittings, etc. He shall promptly furnish and place fill to original grade.

I. 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.

J. 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.

K. If property damage or loss of customer service is involved, the Contractor shall begin work with four (4) hours of notification by Owner.

L. Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

3.4 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.

B. All ductile iron pipe and 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.

C. Such inspection by Owner does not relieve the Contractor of full responsibility for the material installed.

END OF SECTION 33 33 00

SECTION 33 39 15

MANHOLE HEIGHT ADJUSTMENT

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. This section of the specifications provides requirements for the adjustment of height of manholes whose tops are below grade to eliminate the inflow and infiltration of storm or surface water (I&I) into the manhole.

1.2 RELATED SECTIONS

A. Section 31 25 00: Erosion and Sedimentation Control

B. Section 33 05 16.13: Precast Concrete Utility Structures

1.3 REFERENCES

A. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale).

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings.

C. ASTM C270 - 12a Standard Specification for Mortar for Unit Masonry

1.4 SUBMITTALS

A. The Contractor shall submit shop drawings and product data in accordance with the requirements of the Submittals section of these Specifications.

B. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of Work which were incidental to the Work. The Contractor shall include in his daily record and reference to the following:
   1. Delays: Dense traffic, lack of information, sickness, labor or equipment shortage, etc.
   2. Weather: Conditions [e.g., rain (quantity, time, duration), sunny, windy, etc.].
   3. Equipment: On site (e.g., specialty cleaning, by-pass equipment, etc.).

4. Submittals: To the Owner's Engineer or as directed in the submittals portion of these specifications.
5. Personnel: On site by name (e.g., all labor, specialty services, etc.).
6. Accident: Report (e.g., all injuries, vehicles, etc.).
7. Incident: Report (e.g., damage to property, property owner complaint, etc.).
8. Major defects encountered: including, but not limited to, collapsed pipe, if any, cave-ins, sink holes, etc.
9. Visitors: On site, time in and out.
10. Disposals: Type and quantity of debris (including liquids).

C. Ring Product submittal and manufacturer's specifications.

D. Traffic safety plan and procedures for Right-of-Way work.

E. DOT Documents for permit.

1.5 RESPONSIBILITY FOR SANITARY SEWER OVERFLOWS AND DAMAGE TO PROPERTY AND UTILITY

A. It shall be the responsibility of the Contractor to schedule and perform the Work in a manner that does not cause or contribute to incidences of sanitary sewer overflows (SSOs) as defined in the latest Consent Decree.

B. In the event that the Contractor's activities cause or contributes to SSOs, the Contractor shall immediately take appropriate action to immediately notify the Owner's dispatch center and the Owner; contain and/or stop the SSO; document the location, cause, and volume of the SSO; determine and document whether it entered a stream or storm drain (spill); clean up the spillage; and disinfect the area affected by the SSO. For details of spill response refer to the Sanitary Sewer Overflow Contingency and Emergency Response Plan (CERP) approved by Owner. This document can be found on Department of Watershed Management website under the Consent Decree Program or upon request to the Owner.

C. The Contractor shall indemnify and hold harmless the Owner and Owner's representatives for any fines or third-party claims for personal or property damage arising out of an SSO that is fully or partially the responsibility of the Contractor, including the legal, engineering, and administrative expenses of the Owner, Owner's employees, and City elected officials in defending such fines and claims.

D. Any damage to public or private property due to the work performed by the Contractor is the responsibility of the Contractor. Any damage to municipal or private utilities that is caused by the Contractor's equipment or operation shall be repaired in a manner approved by the Owner at the Contractor's expense. Any damage caused by the Contractor to utilities or property belonging to other entities shall be repaired by the Contractor to the satisfaction of the utility/property owner at the Contractor's expense. Any equipment stuck or left in the sewer line/lateral shall be retrieved by the Contractor within twenty-four (24) hours at the sole expense of the Contractor with notification to the Owner. Any

damage to the Contractor's equipment is the Contractor's responsibility. If the equipment that is stuck or left in the sewer line/lateral causes a SSO, then the Contractor is liable for that SSO and all associated damages.

E. The Owner reserves the right to make any repairs or retrieve any equipment and charge the Contractor accordingly.

1.6 SAFETY

A. All work shall be performed in accordance with OSHA, Local and State DOT standards local, state and federal safety regulations.

B. No person shall enter a confined space without the documented requisite training, certification, and entry permits/licensing.

C. The Contractor shall furnish DOT approved barricades around existing manholes to safeguard traffic and pedestrians in accordance with Contractor's approved safety plan.

PART 2 – PRODUCTS

2.1 BRICK

A. Brick shall conform to the requirements of ASTM C32 for grade SM. Bricks shall conform to the following dimensions, unless otherwise approved by the Owner's Engineer:

	Depth (inches)	Width (inches)	Length (inches)
Standard Size	2¼	3¾	8
Allowable Variation	±¼	±¼	±½

B. All brick shall be new and whole, of uniform standard size, and with substantially straight and parallel edges and square corners. Bricks shall be of compact textures, burned hard entirely through, tough and strong, free from injurious cracks and flaws, and shall have a clear ring when struck together. No soft or salmon brick shall be used. Brick shall be culled after delivery, if required, and no culls shall be used except at such places, to such extent, and under such conditions as may be approved by the Owner's Engineer.

2.2 MORTAR

A. The Contractor shall use mortar meeting the requirements of ASTM C270 Type S unless directed and approved otherwise by the Owner's Engineer.

B. The Contractor shall prepare mortar only in quantities needed for immediate use. Mortar which has been mixed for more than thirty (30) minutes or greater than the manufacturers limits, whichever is more strict, which has set, or which has been retempered shall not be used.

2.3 METAL RISER RING

A. Cast Iron: New cast iron riser rings shall be of domestic origin, conform to the latest edition of AASHTO M306. Contractor shall use cast iron riser rings for reconstruction and/or adjustment of the manhole frame and cover of less than 4 inches.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall take all necessary measures to prevent debris from entering the manhole under reconstruction. A temporary (waterproof) cover shall be required during the reconstruction period.

B. The Contractor shall take all necessary measures to prevent damage to the existing manhole frame and cover during the adjustment work.

C. In the event that the existing manhole is being located into a paved area, the Contractor is required to replace existing manhole frame and cover with a traffic manhole frame and cover. The Contractor is also required to provide a traffic safety plan to the Owner if the paved area is within the municipal or state Right-of-Way.

D. Riser Rings: The Contractor shall replace existing, deteriorated riser rings with new precast concrete riser rings and/or cast iron riser rings. All manholes designated to receive casting adjustment and/or alignment shall be adjusted to meet existing finished grade unless an alternative elevation is specified. A cementitious mortar shall be placed in between individual precast concrete riser rings, and precast concrete riser ring and cone joints. The mortar shall be struck smooth with the interior surface of the manhole and floated with a sponge float to a surface profile of 8-10 mils. An epoxy system designed for metal-to-metal adhesion shall be used to connect individual cast iron riser rings and the cast iron riser rings to the frame. Prior to backfilling, rubber external seal wraps shall be applied to the cone and manhole section joint, riser rings and frame.

E. Manhole Frame and Cover: Existing frames and covers which must be removed to facilitate manhole rehabilitation, riser reconstruction, and/or casting alignment or grade adjustments shall be salvaged, cleaned and given two coats of an approved bituminous coating by the Contractor for replacement unless determined to be defective by Engineer. If manhole frame and/or cover are determined to be defective by the Owner, Contractor shall replace with new frame and/or cover. Replacement frames and/or covers shall be furnished and installed in accordance with the Contract Documents. Frames shall be set

in full mortar bed. The mortar shall be struck smooth with the interior surface of the manhole and floated with a sponge float to a surface profile of 8-10 mils.

3.2 MANHOLE ENTRY

A. The Contractor shall exercise extreme caution during any manhole entry operations. Particular attention shall be paid while working on larger diameter sewers. The Contractor shall implement all necessary safety precautions, in accordance with OSHA, local, state, and federal regulations, to give maximum protection at all times to persons or property at or near the Site of the Work.

3.3 PROCEDURES FOR MANHOLE HEIGHT ADJUSTMENT

A. The Contractor shall utilize maps, surveys, sounding instruments, or information from local residents to determine approximate locations of buried manholes. Manholes shall be exposed utilizing hand techniques or by carefully probing with mechanical equipment. Manhole exposure in paved areas shall be accomplished by making a square cut in the surface with sufficient width to allow for the excavation of the material around the manhole to expose it to a depth necessary for adequate adjustment.

B. Raising Manholes:

1. The Contractor shall adjust the top elevation of the manhole frame to grade where indicated on the Plans or as directed by the Owner using brick and mortar conforming to the requirements of this section. A maximum adjustment of twelve (12) inches will be allowed using brick and mortar. Mortar shall be applied to create a smooth finish on the interior and exterior prior to backfill. Adjustments greater than twelve (12) inches shall be made by removing the cone section and adding the appropriate precast riser section.
2. In green (grass) areas, vertical height adjustments can be made using cast iron adjustment (riser) rings in lieu of brick and mortar. A maximum adjustment of twelve (12) inches will be allowed using riser rings. Adjustments greater than twelve (12) inches shall be made by removing the cone section and adding the appropriate precast riser section. The number of riser rings shall be limited to the minimum number that is required to achieve grade.

    a. Joint sealant shall be applied on existing manhole frame and each joint of the riser ring(s) that are required to achieve grade. If the outdoor temperature is below 70 degrees Fahrenheit, the Contractor must heat the joint sealant before application.
    b. The Contractor shall place concrete (Class B) collar (8 inch at the bottom of the frame to 2 inch at the top of the frame) on exterior of the manhole frame. The concrete collar on exterior of the manhole frame shall receive a broom finish.

3. When a manhole height adjustment is performed in a paved area and the manhole is not to be rehabilitated by any other method, then the Contractor shall install a manhole frame seal in accordance with the requirements of these Specifications.

C. Lowering or raising manholes in paved and green areas that require the removal of the manhole cone:

1. If the vertical height adjustment of the existing manhole is greater than 12 inches or the existing manhole must be lowered, the Contractor shall remove the manhole cone section to the straight barrel section of the existing manhole.
2. The manhole frame and cover shall be removed from the existing manhole.
3. The Contractor shall remove of the manhole cone by either the saw cut method or explosive (shot) cord method.
4. The Contractor shall prepare the existing manhole barrel for the re-construction of the cast-in-place manhole as shown on the standard details.
5. The Contractor shall re-construct the cast-in-place concrete manhole as shown on the standard details.
6. If the manhole frame is not reset as part of the cast-in-place concrete manhole pour, the Contractor shall apply a 1½ inch bed of concrete (Class B) for the re-install the manhole frame on the cast-in-place concrete manhole. The Contractor shall also place concrete (Class B) collar (8 inch at the bottom of the frame to 2 inch at the top of the frame) on exterior of the manhole frame. The concrete collar on exterior of the manhole frame shall receive a broom finish.

A. If no sewage flow is observed through the existing manhole, the Contractor shall perform a visual inspection. If sewage flow is observed through the existing manhole, the Engineer and Owner will perform a visual inspection.

3.4 CLEANUP

A. After the work has been completed and all testing acceptable, the Contractor shall clean up the work area in accordance with these specifications.

B. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor. The debris and liquids are to be disposed of properly in accordance with all applicable laws. Debris and liquids type and quantities are to be tracked in the daily contractor diary. Hauling and disposal costs will be borne by the contractor.

C. The work area shall be left in a condition equal to or better than prior condition. Disturbed grassed areas shall be seeded or sod placed as directed by the Owner’s Engineer at no additional cost to the Owner. The work site restoration work shall be completed in accordance with the requirements of the Site Restoration section of these Specifications.

3.5 WARRANTY

A. The Contractor shall guarantee the work for a warranty period of one (1) year from the date of final written acceptance of the Owner. If, at any time during the warranty period, any defect is identified the Contractor shall make repairs acceptable and at no additional cost to the Owner. In this case, the Contractor shall warrant the work for one (1) year in addition to the warranty required by the Contract from the date of repairs' final written acceptance.

B. If the frequency of similar defects requiring repair increases, then the entire project will be re-evaluated for warranty extensions.

END OF SECTION 33 39 15

SECTION 33 41 00

STORM UTILITY DRAINAGE PIPING

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:

1. Pipe and fittings.
2. Non-pressure transition couplings.
3. Pressure pipe couplings.
4. Expansion joints and deflection fittings.
5. Backwater valves.
6. Cleanouts.
7. Drains.
8. Encasement for piping.
9. Manholes.
10. Channel drainage systems.
11. Catch basins.
12. Stormwater inlets.
13. Stormwater detention structures.
14. Pipe outlets.
15. Dry wells.
16. Stormwater disposal systems.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. HDPE WT: High density polyethylene pipe with water tight joints.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 HDPE Water Tight (WT)

A. Pipe and Fittings
1. ADS N-12 WT IB pipe (per AASHTO) shall have a smooth interior and annular exterior corrugations.
   a. 4- through 10-inch (100 to 250 mm) pipe shall meet AASHTO M252, Type S.
   b. 12- through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
   c. Manning's "n" value for use in design shall be 0.012.

B. Joint Performance
1. Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294,or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly. 12- through 60-inch (300 to 1500 mm) diameters shall have an exterior bell wrap installed by the manufacturer.

C. Fittings
1. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

D. Field Pipe and Joint Performance
1. To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

E. Material Properties
1. Virgin material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm)

virgin pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

F. Installation

1. Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4- through 48-inch (100 to 1200 mm) diameters shall be one foot. (0.3 m) and for 60-inch (1500 mm) diameter the minimum cover shall be 2 ft. (0.6 m) in single run applications. Backfill for minimum cover situations shall consist of Class 1 (compacted), Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level; please refer to Technical Note 2.01. Contact your local ADS representative or visit our website at www.ads-pipe.com for a copy of the latest installation guidelines.

G. Pipe Dimensions

1. Inside Diameter 15 inch / Outside Diameter 18 inch
2. Inside Diameter 18 inch / Outside Diameter 22 inch
3. Inside Diameter 24 inch / Outside Diameter 28 inch
4. Inside Diameter 30 inch / Outside Diameter 36 inch

2.2 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A 716, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

A. Mechanical-Joint Piping:

1. Pipe: AWWA C151, with bolt holes in bell.
2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
3. Compact Fittings: AWWA C153, with bolt holes in bells.
4. Glands: Cast or ductile iron, with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

2.4 PVC PIPE AND FITTINGS

A. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, SDR 26, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

C. PVC Pressure Piping:

1. Pipe: AWWA C900, Class 100, Class 150,and Class 200 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 100, Class 150 and Class 200 PVC pipe with bell ends
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, SDR 26 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 2467, Schedule 80 PVC, socket type.

2.5 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Tongue-and-groove ends and gasketed joints with ASTM C 443.

2.6 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Concrete Pipes: ASTM C 443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Pipe.
d. Mission Rubber Company; a division of MCP Industries, Inc.
e. NDS Inc.
f. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

3. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Cascade Waterworks Mfg.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company; a division of MCP Industries, Inc.

3. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Fernco Inc.
b. Logan Clay Pipe.
c. Mission Rubber Company; a division of MCP Industries, Inc.

3. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.7 PRESSURE PIPE COUPLINGS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Cascade Waterworks Mfg.
2. Dresser, Inc.
3. Ford Meter Box Company, Inc. (The); Pipe Products Div.
4. JCM Industries, Inc.
5. Romac Industries, Inc.
6. Smith-Blair, Inc.; a Sensus company.
7. Victaulic Depend-O-Lok, Inc.
8. Viking Johnson.

C. Description: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

D. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 200-psig minimum pressure rating and ends sized to fit adjoining pipes.

E. Center-Sleeve Material: Manufacturer's standard.

F. Gasket Material: Natural or synthetic rubber.

G. Metal Component Finish: Corrosion-resistant coating or material.

2.8 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron Flexible Expansion Joints:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. EBAA Iron Sales, Inc.
b. Romac Industries, Inc.
c. Star Pipe Products.

3. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Expansion Joints:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Dresser, Inc.
   b. EBAA Iron Sales, Inc.
   c. JCM Industries, Inc.
   d. Smith-Blair, Inc.; a Sensus company.

3. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron[or steel with protective coating], bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated.

C. Ductile-Iron Deflection Fittings:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. EBAA Iron Sales, Inc.

3. Description: Compound-coupling fitting, with ball joint, flexing section, gaskets, and restrained-joint ends, complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for up to 15 degrees of deflection.

2.9 BACKWATER VALVES

A. Cast-Iron Backwater Valves:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Tyler Pipe.
   d. Watts Water Technologies, Inc.

e. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
f. <Insert manufacturer's name>.

2. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
3. Horizontal type; with swing check valve and hub-and-spigot ends.
4. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
5. Terminal type; with bronze seat, swing check valve, and hub inlet.

B. Plastic Backwater Valves:

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:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Canplas LLC.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

3. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.10 CLEANOUTS

A. Cast-Iron Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
3. Top-Loading Classification(s): Extra-Heavy Duty.
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:
1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

a. Canplas LLC.
b. IPS Corporation.
c. NDS Inc.
d. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
e. Sioux Chief Manufacturing Company, Inc.
f. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.11 DRAINS

A. Cast-Iron Area Drains:
1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. Josam Company.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.6.3 gray-iron round body with anchor flange and round[secured] grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
3. Top-Loading Classification(s): Heavy Duty.

B. Cast-Iron Trench Drains:

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

a. Josam Company.

b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.
d. Tyler Pipe.
e. Watts Water Technologies, Inc.
f. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.6.3, 6-inch- wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.
3. Top-Loading Classification(s): Extra-Heavy Duty.

2.12 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Designed Precast Concrete Manholes:

1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: Individual FRP steps, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
6. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

2.13 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

    a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

    a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

E. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

F. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.14 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
8. Steps: Individual FRP steps, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.
2. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.
4. Steps: Individual FRP steps, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
5. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.15 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty, according to utility standards.

2.16 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
3. Steps: Individual FRP steps, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.17 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-3, screen opening 2 inches.
2. Average Size: NSSGA No. R-4, screen opening 3 inches.
3. Average Size: NSSGA No. R-5, screen opening 5 inches.

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

2.18 DRY WELLS

A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:

1. Floor: Cast-in-place concrete.
2. Cover: Liftoff-type concrete cover with cast-in lift rings.
3. Wall Thickness: 4 inches minimum with 1-inch diameter or 1-by-3-inch- maximum slotted perforations arranged in rows parallel to axis of ring.

a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
b. Ring Construction: Designed to be self-aligning.

4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

B. Description: Manufactured PE side panels and top cover that assemble into 50-gal. storage capacity units.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product or comparable product by one of the following:

a. NDS Inc.

2. Side Panels: With knockout ports for piping and seepage holes.
3. Top Cover: With knockout port for drain.
4. Filter Fabric: As recommended by unit manufacturer.
5. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

C. Description: Constructed-in-place aggregate type. Include the following:

1. Lining: Clay or concrete bricks.
2. Lining: Concrete blocks or precast concrete rings with notches or weep holes.
3. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.
4. Cover: Precast, reinforced-concrete slab, designed for structural loading according to ASTM C 890 and made according to ASTM C 913. Include slab dimensions that will extend 12 inches minimum beyond edge of excavation, with bituminous coating over entire surface. Cast cover with opening for manhole in center.
5. Manhole: 24-inch- diameter, reinforced-concrete access lid with steel lift rings. Include bituminous coating over entire surface.

2.19 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

2.20 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 24-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
7. Install corrugated steel piping according to ASTM A 798/A 798M.
8. Install corrugated aluminum piping according to ASTM B 788/B 788M.
9. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PE corrugated sewer piping according to ASTM D 2321.
11. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
14. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.
15. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
16. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
17. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

1. Hub-and-spigot, cast-iron soil pipe and fittings.

2. Hubless cast-iron soil pipe and fittings.
3. Ductile-iron pipe and fittings.
4. Expansion joints and deflection fittings.

2.21 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
7. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
8. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
9. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
10. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
11. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
12. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
13. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
14. Join fiberglass sewer piping according to ASTM D 3839 for elastomeric-seal joints.
15. Join nonreinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
16. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
17. Join dissimilar pipe materials with nonpressure-type flexible couplings.

2.22 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

2.23 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
3. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

2.24 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

2.25 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

2.26 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

2.27 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

2.28 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 4-inch minimum concrete around bottom and sides.

2.29 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

2.30 CONNECTIONS

A. Connect drainage piping in building’s storm building drains specified in division.

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to sediment interceptors specified in Section 221323 "Sanitary Waste Interceptors."

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. [Unshielded] [Shielded] flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

2.31 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use[warning tape or] detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

2.32 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping according to ASTM F 1417.
    c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

2.33 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 33 41 00

SECTION 33 41 13

REINFORCED CONCRETE PIPE FOR STORM DRAINS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals necessary to install reinforced concrete pipe and fittings as shown on the drawings and required by the Specifications.

1.2 SHOP DRAWINGS

A. Submit shop drawings showing piping and drainage structure layout and details of reinforcement, joint and method of construction and installation of reinforced concrete pipe, specials, and fittings required.

1.3 RELATED WORK

A. Section 312000: Excavation, Backfill, Fill and Grading for Pipe

B. Section 017420: Miscellaneous Work and Clean-up

C. Division 3: Concrete

D. Division 4: Mortar

PART 2 - PRODUCTS

2.1 REINFORCED CONCRETE PIPE

A. Except as otherwise specified within, pipe shall conform to ASTM Standard Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Designation C76, Class III, Wall B. The tabulated reinforcement given in the tables in ASTM Standard C76 shall be the minimum required.

B. The pipe shall be capable of withstanding construction equipment loading which may be encountered during the progress of work. Any pipe damage during construction operations shall be promptly and satisfactorily repaired.

C. Non-air-entraining Portland cement conforming to ASTM Specification C150, Type I shall be used, except as otherwise approved in writing. The use of a non-bleeding,

water-reducing, dispersing agent may be permitted subject to the specific approval. The use of any other admixture will not be permitted.

D. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C33, except for gradation, with a maximum loss of 5% when subjected to 5 cycles of the soundness test using magnesium sulfate.

E. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM Specification C33, with a maximum loss of 5% when subjected to 5 cycles of the soundness test using magnesium sulfate.

F. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe shall be not less than 4,000 psi. The pipe interior shall comprise a continuous integral cement skin and shall be smooth and even, free from roughness, projections, indentations, offsets or irregularities. The concrete mass shall be dense and uniform. The average absorption shall not exceed 5.3%. Reinforcement shall be circular for all concrete pipe. Reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling and installation. Cores indicating reinforcing steel having less than 85% bond shall be cause for rejection of the lot of pipes.

G. The pipe shall be clearly marked as required by ASTM C76. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until compressive strength of the concrete has attained 3,000 psi and not before 5 days after manufacture and/or repaired, whichever is the longer.

H. Pipes shall have a minimum laying length of approximately 8', except for closure and other special pieces. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4', except where the joint is cast flush with the exterior wall of the structure. Maximum laying length shall not exceed 16', but the installation of 16' lengths will depend upon the ability of the Contractor to handle such lengths of pipe. In deep sheeted trenches comply with trench width requirements, maintain the integrity of the sheeting and avoid disturbance to adjacent ground. If in the opinion of the Owner's Representative the use of 16' lengths is impracticable, shorter lengths shall be used.

I. The quality of all materials and the finished pipe shall be subject to inspection and approval of a representative of the Owner. Such inspection may be made at both places, and the pipe shall be subject to rejection at any time because of failure to meet any of the specification requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

J. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM and project specification, and inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, and other features. All pipes will be checked for soundness by being tapped and scratched over a reasonable portion of the area, at least once on every 20 sq. inches of pipe surface. The surface shall be dense and close-textured. Cores shall also serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.

K. The manufacturer shall inspect all pipe joints for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish a notarized affidavit stating all pipes meet the requirements of ASTM C76, these specifications, and the joint design with respect to square ends and out-of-round joint surfaces.

L. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only that pipe actually conforming to the specifications and accepted will be listed for approval, shipment and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected, and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced.

M. Pits, blisters, rough spots breakage and other imperfections may be repaired, subject to the approval of the Owner's Representative, after demonstration by the manufacturer that strong permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3" cylinders store in the standard manner. Epoxy mortar may be utilized for repairs.

2.2 JOINTS FOR CONCRETE PIPE

A. Joints for concrete pipe shall be the tongue and groove or bell and spigot type of joint with provisions for using a round rubber "0-Ring" gasket in recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between 1-1/2 degree and 2-1/2 degree and the annular open spaced at the gasket when the joint is made up and pipes are centered in line shall not exceed 1/8". The faces of pipe in contact with the gasket shall be true, and free of irregularities. Joints for drain pipe may be made with mortar.

B. The round rubber "0-Ring" gaskets for either joint shall conform to ASTM C443 Specifications for joints for Circular Concrete Sewer and Culvert Pipe using rubber gaskets.

PART 3 - EXECUTION

3.1 LAYING REINFORCED CONCRETE PIPE FOR DRAINS

A. Bell and spigot pipe joints shall be made by caulking all around with twisted jute of proper size to give proper alignment of the pipe. Inner surfaces of abutting sections shall be flush and on a smooth grade. Brush and wet the jointing surfaces and fill the annular opening with mortar to a minimum depth of 2", sufficient to form a bead around the outside face of the bell.

B. Mortar for jointing shall consist of one part Portland cement and two parts sand, using a minimum amount of water-sufficient to make a workable mortar.

C. Joints shall be immediately protected from freezing or excessive drying by covering with earth, burlap or other approved material.

3.2 CLEANING

A. At the conclusion of the work, thoroughly clean all of the new pipe lines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. Debris cleaned from the lines shall be removed from the lowest outlet. If, after this outlet cleaning, obstructions remain, they shall be removed.

END OF SECTION 33 41 13

SECTION 34 41 16.10

TRAFFIC CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Materials
2.2	Worker Safety Apparel
2.3	Traffic Control Devices
3.1	Maintaining Traffic
3.2	Traffic Control

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Submittal Procedures (01 33 00).
2. Exploratory Excavations (02 32 19).
3. Paving Removal (02 41 13.13)
4. Utility Line Removal (02 41 13.23)
5. Removal of Construction Material (02 42 11)
6. Clearing and Grubbing (31 11 00)
7. Excavation and Fill (31 23 00).
8. Erosion and Sedimentation Controls (31 25 00).
9. Removing and Replacing Pavement (32 12 16)
10. Sidewalks, Curbs, and Gutters (32 16 13)
11. Roadway Construction (34 71 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**.**

1.3 WORK INCLUDED

A. The Contractor shall furnish all materials, equipment, and labor (including employment of off-duty Forsyth County Police Officer(s)), necessary to maintain traffic control during construction. This Work shall consist of furnishing, installing, maintaining, and removing necessary traffic signs, pedestrian signs, barricades, lights, signals, cones, pavement markings, and other traffic control devices, and shall include flagging and

other means for guidance and protection of vehicular, worker, and pedestrian traffic through the Work Zone. This Work shall include both maintaining existing devices and installing additional devices, as necessary, in construction work zones.

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.

B. Submittals shall show in detail, the type, number, and location of all traffic control measures to be used in the execution of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified, all materials furnished for traffic control shall meet the requirements of the Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges, Sections 148 and 150, latest edition; Georgia Department of Transportation, Special Provision, Section 150-Traffic Control, latest edition; and the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

2.2 WORKER SAFETY APPAREL

A. All workers within the right-of-way who are exposed to traffic or to work vehicles and construction equipment shall wear high-visibility safety apparel that meets the Performance Class for the risk exposure.

2.3 TRAFFIC CONTROL DEVICES

A. All traffic control devices used during the execution of the Work shall meet the Standards utilized in the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

PART 3 - EXECUTION

3.1 MAINTAINING TRAFFIC

A. All working operations of the Contractor, Subcontractors, and/or their agents or employees must be subordinated to the free and unobstructed use of the highway, and structures encountered in the prosecution of the Work under this item.

B. The Contractor shall proceed with the Work in such manner as shall permit regular transaction of business by the GCDOT and/or property owner without delay or danger to life or property, and shall place necessary barricades, warning signs, signals, lights, and if necessary, flaggers or Police Officer(s) for the protection of the traveling public.

C. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give a minimum of twenty-four (24) hour notice to owner(s)/tenant(s) of private drives before interfering with them.

D. In making open-cut street crossings, Contractor shall not block more than one-half (½) of the street at a time. Whenever possible, Contractor shall widen the shoulder on the opposite side of the street to facilitate traffic flow.

3.2 TRAFFIC CONTROL

A. Contractor's proposed plan of operation shall supplement the approved traffic control plan as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

B. All traffic control devices shall be in an acceptable condition when first installed on the Project and shall be maintained throughout the construction period. All unacceptable traffic control devices shall be replaced within twenty-four (24) hours.

C. In the execution of the Work, if it becomes necessary to remove any existing signs, markers, etc., they shall be removed, stored and reinstalled as directed by the Engineer or CUMMING UTILITIES, to line and grade in the same condition as when removed.

D. All temporary traffic control devices shall be removed within seven (7) calendar days after completion of construction.

E. When necessary to provide a safe work zone for the Contractor and CUMMING UTILITIES employees, off-duty Police Officer(s) may be utilized to assist in maintaining safe traffic control. Use of Police Officer(s) shall be used when safety necessary, in areas of high traffic volume, installation in roadways, road closures and lane closures, or in areas of low visibility. The Contractor shall contact the Forsyth County Police Department Uniform Division Office at (678) 513-5976 to schedule an off-duty Police Officer(s). Arrangements for Police Officer(s) must be made a minimum of forty-eight (48) hours prior to the Work to allow time for Police Officer(s) to be scheduled. Depending on the situation, the Police Officer(s) onsite may request additional Police Officer(s), if needed.

END OF SECTION 34 41 16.10

SECTION 34 71 00 ROADWAY

CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. SECTION INCLUDES:

Section	Title
1.2	References
1.3	Work Included
1.4	Submittals
2.1	Materials
3.1	General Conditions
3.2	Materials and Workmanship
3.3	Restoring Driveway and Parking Area Pavements
3.4	Roadway Permits
3.5	Restoring Roadway Pavements

B. RELATED SECTIONS

The following listed sections do not purport to be all inclusive, as it is the Contractor's responsibility to do all the Work in accordance with the Contract Documents.

1. Submittal Procedures (01 33 00)
2. Paving Removal (02 41 13.13)
3. Removal of Construction Material (02 42 11)
4. Cast-in-Place Concrete (03 30 00).
5. Excavation and Fill (31 23 00).
6. Removing and Replacing Pavement (32 12 16).
7. Sidewalks, Curbs, and Gutters (32 16 13)

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. Forsyth County Department of Transportation Standard Specifications.

1. Where section numbers are identified throughout this specification, the reference is to the Georgia Department of Transportation Standard Specifications, Construction of Roads and Bridges, latest edition.

1.3 WORK INCLUDED

A. The Contractor shall furnish all labor, equipment, and materials necessary to restore all pavements (parking areas, driveways, sidewalks, curbs, gutters, etc.) of whatever

construction and irrespective of the type, which may be damaged, disturbed, or required to be removed in the process of the Work.

B. These items shall include in general, but without limitation, all necessary concrete, reinforcing steel, stone, gravel, asphalt and other bituminous material necessary for the proper completion of the Work as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES.

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.

B. The Contractor shall furnish samples, manufacturer's product data, test reports, and material certifications as required above in Paragraph 1.1.B RELATED SECTIONS.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For asphalt and other bituminous paving, refer to Specification SECTION 32 12 16 REMOVING AND REPLACING PAVEMENT, PART 2 – PRODUCTS.

B. For concrete paving, sidewalks, curbs, and gutters, refer to Specification SECTION 32 16 13 SIDEWALKS, CURBS, AND GUTTERS, PART 2 – PRODUCTS.

PART 3 - EXECUTION

3.1 GENERAL CONDITIONS

A. Contractor's attention is directed to the provisions of Specification SECTION 31 23 00 EXCAVATION AND FILL**,** Paragraph 3.1 BACKFILLING, requiring Final and Sub-base backfill and compaction of backfill under areas to be paved. Any settlement which may occur during the Warranty Period of one (1) year following Substantial Completion certification, shall be corrected at the Contractor's expense, including repaving and/or replacing of streets, curbs, gutters, parking areas, and driveways which settle during the Warranty Period.

B. The Contractor shall repave all areas over trenches in public streets as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES, promptly after completion of Final and Sub-base backfill to provide full use of the street with a minimum of delay.

C. No additional payment shall be made for excavation or disposal of excavated material required for placement, or removal of backfill placed above the required elevation of the pavement or for preparation of sub grade, and the cost thereof shall be considered as being included in the Unit Prices Bid for paving and curbing items.

D. Should settlements, cracks, or other indications of failure appear in adjoining pavements, the adjoining damaged paving shall be removed per provisions of SECTION 02 41 13.13 PAVING REMOVAL, Paragraph 3.1 TRENCH PAVING REMOVAL, to the extent necessary to secure firm, undisturbed bearing, and shall be repaved to Standards as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative.

E. Where necessary to cut a concrete sidewalk, driveway, or parking area, entire slabs or sections shall be removed and replaced to an edge of paving or joint, unless otherwise directed by CUMMING UTILITIES.

F. The Contractor shall replace all sidewalks removed or disturbed by the process of the Work in accordance with SECTION 32 16 13 SIDEWALKS, CURBS, AND GUTTERS. Sidewalks shall be constructed to the same dimensions and materials as were originally placed. The sub-base shall be thoroughly rolled or tamped and shall be wet just before, if necessary, concrete is placed, but shall show no pools of water.

G. The Contractor shall restore all curbs, combination curbs and gutters, which have been removed or disturbed in the process of the Work in accordance with SECTION 32 16 13 SIDEWALKS, CURBS, AND GUTTERS. Curbs and gutters shall be made to conform accurately in size, line, grade, and materials as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES. In restoring curbs and gutters, the subsoil and foundation material shall be compacted as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative, so as to prevent any settlement of concrete curb and/or gutter.

H. In paved areas, the Contractor shall adjust all utility structures (manhole frame/cover, vault tops, valve boxes, etc.) to final grade per provisions of SECTION 33 05 16.13 PRECAST CONCRETE UTILITY STRUCTURES.

3.2 MATERIALS AND WORKMANSHIP

A. Materials to be used in the repair and restoration of pavements, driveways, sidewalks, and curbs and gutters shall be as specified above in this section in Paragraph 2.1 MATERIALS. All materials removed during the excavation of the Work shall be disposed of by the Contractor per provisions of SECTION 02 42 11 REMOVAL OF CONSTRUCTION MATERIAL. All workmanship shall be first class.

3.3 RESTORING DRIVEWAY AND PARKING AREA PAVEMENTS

A. The Contractor shall restore driveway and parking area pavements removed or disturbed during construction. After the pipe has been laid, appurtenant work constructed and backfill completed, the Contractor shall furnish, place and maintain wherever the pavements have been removed or damaged in the process of the Work, asphaltic concrete surfaces, concrete surfaces, or stone surfaces as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES. Driveways and parking areas shall be constructed as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative, but concrete shall not be less than 4 inches thick. Surface finish is to match existing; edges are to be saw cut in straight lines, both horizontally

and vertically; expansion joints to

be used as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative. In general, concrete driveways shall be replaced from back of curb to a point ten (10) back from back of curb, or to the closet expansion joint nearest the construction disturbance. The limits of this type of restoration shall be approved by CUMMING UTILITIES prior to construction of that area in order to determine payment quantities.

B. All Concrete shall conform to Specification SECTION 03 30 00 CAST-IN-PLACE CONCRETE, Paragraph 2.1 CONCRETE.

3.4 ROADWAY PERMITS

A. The Contractor's attention is called to the requirements that Contractor must obtain all road opening permits from FCDOT, and must assist CUMMING UTILITIES in obtaining all permits required by the Georgia Department of Transportation.

B. All fees shall be borne by the Contractor.

3.5 RESTORING ROADWAY PAVEMENTS

A. The Contractor shall restore roadway pavements removed or disturbed during construction. After the pipe has been laid, appurtenant work constructed, and backfill completed, the Contractor shall furnish, place, restore and maintain wherever the pavements or road surfaces have been removed or damaged in the process of the Work, asphaltic concrete surfaces, concrete surfaces, or stone surfaces as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative.

B. All roadway restoration shall be done, and all highway utilities and traffic controls are to be maintained, in accordance with the laws, ordinances, rules, regulations and Standards, including the use of standard signs, of the jurisdictional authority in which such pavement is located. The Contractor shall provide all such bonds or checks, which may be required by the highway authorities to ensure proper restoration of paved areas, at no cost to CUMMING UTILITIES. All road closures and detours must be submitted and approved by the authorities within whose jurisdiction they are located.

C. The Contractor shall resurface the entire street from curb to curb, or any other area as directed by the Engineer or CUMMING UTILITIES. Asphaltic concrete paving shall conform to the requirements of SECTION 32 12 16 – REMOVING AND REPLACING PAVEMENT.

D. If prior to the expiration of the Warranty Period, the asphalt, concrete or stone road surfaces within the lines of excavation, or adjacent thereto, shall have been damaged or injured, due to undermining, or for any other cause which may be attributed to the Work by the Contractor, then the Contractor shall remove such damaged or injured surfaces, foundations of same, and all loose earth. Contractor shall then backfill and compact damaged area as specified, as indicated on the Drawings, or as directed by the Engineer or CUMMING UTILITIES construction material testing representative, and furnish, place, and maintain an asphalt, concrete or stone road surface until the Warranty Period has expired.

E. Asphalt, concrete or stone road surfaces, which the Contractor is required to replace, shall at the expiration of the Warranty Period, be in as good or better condition than at the time of Contract award.

F. All cuts required in restoring pavements shall be made by channeling machine, pneumatic tools, or such other methods as shall furnish a clean, straight cut both horizontally and vertically, in the pavement and pavement base without undue shattering.

END OF SECTION 34 71 00

SECTION 40 90 01

GENERAL REQUIREMENTS FOR INSTRUMENTATION AND CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	References
1.3	Administrative Requirements
1.4	Submittals
1.5	Quality Assurance
1.6	Field Conditions
1.7	Warranty
2.1	General
2.2	Nameplates
3.1	Installation
3.2	Field Tests and Inspections
3.3	Attachments

B. Scope

1. This section specifies general requirements which are applicable to providing a complete, functional process control, instrumentation, communication, and signal systems for the Gwinnett County Pump Station Project. The requirements of this section are applicable to all work specified in Division 40 of these specifications.
2. Electrical requirements applicable to this work include those specified in Section 26 00 01 for general electrical requirements; Section 26 00 02 for electrical devices; and Section 26 09 01 for control panels.

C. Description of Work

1. Instrumentation and Control System:
   a. Large Pump Station:
      1) Supply a single pump station control panel (PSCP) which houses the PLC, OIT, and remote telemetry equipment.

2) Perform all work and provide materials which comply with the National Electrical code and applicable local regulations and ordinances. Where required by applicable codes, cabinet assemblies, materials and equipment shall be approved, identified, labeled or listed by Underwriters' Laboratories.

2. Programming: Programming shall be provided per Section 40 96 35.

D. Functional Requirements

1. The instrumentation and control system functions are shown on the drawings and specified in subsequent sections of Division 40. The Systems Integrator drawings and integration practices shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

1.2 REFERENCES

A. Definitions

1. General: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications shall be as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

2. Two-Wire Transmitter: A transducer which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a 24 volt direct current driving potential and a maximum circuit resistance of 600 ohms.

3. Four-Wire Transmitter: A transducer which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a maximum circuit resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.

4. Galvanic Isolation: Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.

5. Panel: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be present in the atmosphere.

6. Data Sheets: Data sheets shall refer to ISA S20 or ISA TR20.00.01.

7. Signal Types: Used in systems specified in Division 40:
    a. Low-Level Analog: Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.
    b. High-Level Analog: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4-20 mA transmission.
    c. Digital Code: Coded information from the output of an analog to digital converter or digital transmission terminal.
    d. Pulse Frequency: Counting pulses emitted from speed or flow transmitters.
    e. Modulated Signals: Signals from modems or low level audio signals. Normal signal level: plus 4 dBm to minus 22 dBm. Frequency range is 300 to 10,000 Hertz.
    f. Discrete Control or Events: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits.
    g. Low Voltage Discrete Control or Events: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits operating at less than 30 volts and 250 milliamperes.
    h. High-Level Audio Signals: Audio signals exceeding plus 4 dBm, including loudspeaker circuits.
    i. Radio Frequency Signals: Continuous wave alternating current signals with fundamental frequency greater than 10 kilohertz.
8. Systems Integrator: A firm engaged in the business of detailed control system design and engineering, instrumentation component purchase, system and panel assembly, programming, and implementing the specified process control and industrial automation systems.

B. Reference Standards

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).
3. 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.

4. 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
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Submittal Conference

1. Schedule a pre-submittal conference with the Owner and Engineer within 30-calendar days after Contract award to discuss the work, equipment, submittal format, and establish the framework for project coordination and communication.
2. Provide materials 10-days prior to the conference:
   a. Instrument Index that lists the devices and instruments specified in Division 40. Identify each by tag number, description, function, manufacturer, and model number.
   b. Product descriptive literature with a statement that the item is as specified.
   c. Proposed equal products with comparative listing of the published specifications for the specified item and the proposed item.
   d. Project schedule with deliverables and milestones.
   e. Project Control System Block Diagram, when specified.
   f. Sample portion of documented PLC and Operator Interface program, when specified.
   g. Sample Spec. 40 95 16 control panel schematic diagram proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.
   h. Sample analog and discrete loop diagrams proposed for this project, when specified. Sample can be a copy from a previous project provided that it represents the format being proposed for this project.

i. 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. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested 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.

3. The pre-submittal conference will not replace the Product and Shop Drawing Submittal review process.

B. Process Equipment Coordination

1. Coordinate Division 40 specified equipment for proper operation with equipment related process equipment specified in other Divisions.
2. Integrate, furnish, and install equipment in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.
3. Systems Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.
4. Systems Integrator shall coordinate with project subcontractors and equipment suppliers.
5. Systems Integrator shall provide on-site installation supervision for the duration of the project.
6. Present conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., to the Engineer for resolution before proceeding.

1.4 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data
   a. Detailed product literature, showing product specifications and model number breakdown. Mark to denote features and options included. Include only the applicable pages.
   b. Nameplate list with material, tag number and description as specified herein.

c. Data Sheets in accordance with ISA 20 for each instrument. Identical instruments may be submitted with one common ISA Data Sheet and accompanying tag list.

2. Shop Drawings

a. General:

1) The drawings included in the project manual are functional in nature and do not show exact locations of equipment or interconnections between equipment. The Contractor's Systems Integrator shall prepare detailed installation drawings as specified below.

2) Drawings prepared in an AutoCAD version current with file format 2013 with borders and title blocks identifying the project, system, revisions to the drawing, and type of drawing. Each revision of a drawing shall include the date and description of the revisions. Drawing prints shall be 11" x 17" with a minimum lettering size of 1/8".

3) Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers in compliance with panel wiring, Section 26 00 01 and Section 40 95 16, to permit cross-referencing between contract documents and the drawings prepared by the Contractor.

b. Connection Diagrams: Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices within the panel. Show terminal blocks used for internal wiring or field wiring, identified as such. Indicate insulation color code, signal polarities, and wire numbers and terminal block numbers.

c. Interconnection Diagrams: Show panels, panel devices, and field devices with wire numbers, cable numbers, raceway numbers, terminal box numbers, terminal block numbers, panel numbers, and field device tag numbers.

d. Elementary or Schematic Diagram: Shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. Provide schematics for internal panel power distribution, lighting, and any panel HVAC.

e. Arrangement, Layout, or Outline Drawings: Show the dimensioned external and interior control panel views with components and Bill of Material. Provide panel heat load calculations, and indicate cooling or ventilation provisions as required.

f. Network Block Diagram: A network block diagram is a diagram of the overall SCADA system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols.

3. Manufacturer's Instructions
    a. Manufacturer's installation manual excerpts, as to be used for this project:
        1) Installation details/drawings.
        2) Electrical connection diagrams
        3) Calibration procedures.
4. Special Procedure Submittals
    a. 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. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested 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.
    b. Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Closeout Submittals
1. Operation and Maintenance Data
    a. Provide operating and maintenance information in accordance with Section 01 78 23. Include the following in each Operation and Maintenance manual:
        1) Final reviewed Submittals, including revised as-built record drawings.
        2) Manufacturer's operation and maintenance instructions, edited for this project.
        3) Written record of menu configuration, jumpers, switch settings, and other configurable parameters for each instrument.
2. Record Documentation
    a. Provide record drawings specified by paragraph 1.4.A.2 and the schedules included in Division 40 in accordance with the latest AutoCAD format and PDF format on CD.
    b. Provide record drawing prints of all drawings following project start-up, but prior to acceptance of the work showing the final constructed state of the instrumentation and control systems.

1.5 QUALITY ASSURANCE

A. System Integrator Responsibility

1. The specified control system and instrumentation integration including panel building, instrument calibration, testing, start-up, operational testing, and training shall be performed by a Systems Integrator staffed with qualified personnel, possessing necessary equipment and experience in performing similar installations.
2. The control system components shall, as far as practical, be of one manufacturer.
3. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.
4. The overall system performance shall be demonstrated to and accepted by Owner.
5. The application software packages shall be latest versions available, or compatible with existing software currently in use.

B. System Integrator Qualifications

1. The following Systems Integrators are pre-qualified to perform the work specified in Division 40 without the need to provide Evidence of Experience:
   a. M/R Systems, Norcross, GA
   b. C2I, Smyrna, GA
   c. Global Control Systems, Smyrna, GA
   d. Revere Control Systems, Birmingham, AL
   e. Turbitrol, Austell, GA
   f. Sta-con, Apopka, FL
   g. Transdyn, Duluth, GA
2. Contractor-proposed Systems Integrator shall be evaluated based on submittal of the following Evidence of Experience:
   a. Submit evidence of experience in performing three similar successful projects in the last five years with one project currently in progress or completed within the last two years.
   b. Submit project descriptions with contact names, addresses, and telephone numbers from the project Owner, General Contractor, and Principal Design Firm.
   c. Submit organization chart and resumes for proposed project personnel.

d. Submit Training and Certification information. Completion of the following training courses or appropriate portions thereof or possession of the following certifications included with the Systems Integrator's personnel experience requirements described above:

1) Project manager: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

2) Systems engineer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration, or completion of the relevant core courses in the Engineering Skills Training program.

3) Programmer: Control System Engineer (CSE) registration, Professional Engineer (PE) registration.

4) Field instrument technician: Certified Control Systems Technician (CCST) registration or completion of the relevant core courses in the Technical Skills Training program.

5) Certified training programs, as offered by ISA.

e. Submit financial data for Systems Integrator division when subsidiary to a parent corporation. Include two years of financial data.

1) Financial Statement.

2) Balance Sheet.

3) Dun & Bradstreet Report.

C. Factory Acceptance Test (FAT)

1. Refer to Section 40 98 00

1.6 FIELD CONDITIONS

A. Provide specified data communication and process control equipment suitable for operation in indoor locations and in outdoor locations.

B. Ambient Conditions

1. Temperature Range: -20˚F to 120˚F.

2. Relative Humidity: 0 to 100%.

3. Potential for direct sunlight.

C. Corrosive Locations

1. Corrosive locations shall be as specified in Division 26.

D. Hazardous (Classified) Areas

1. Hazardous areas shall be as specified in Division 26.

1.7 WARRANTY

A. Manufacturer Warranty

1. Provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01 78 33.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and Quality

1. Provide equipment material that is new, free from defects, and industrial-grade, as specified. Where possible, use one manufacturer for each type of instrument, instrument accessory, and device used throughout the work.
2. Provide electronic equipment of solid-state construction with printed or etched circuit boards of glass epoxy of sufficient thickness to prevent warping.

B. Enclosures

1. Table A specifies the instrument and control panel enclosure material and minimum NEMA rating for the location and application.

Location	Enclosure Material and NEMA Rating
Indoor: Architecturally Finished Area	NEMA 12: mild steel
Indoor: Electrical Room	NEMA 12: mild steel
Indoor: Process Areas	NEMA 4X: 316 Stainless Steel
Indoor: Corrosive Area	NEMA 4X: 316 Stainless Steel
Outdoor: Corrosive Area	NEMA 4X: 316 Stainless Steel
Outdoor: Non-Corrosive Areas	NEMA 4X: 316 Stainless Steel
Corrosive Area (Hypochlorite	NEMA 4X: Non-metallic
Hazardous Area:	NEMA 7: Galvanized Malleable Iron or Aluminum or NEMA 4X and UL listed or FM Approved for the Hazardous Area
Hazardous and Corrosive Area	NEMA 7: Iron or Aluminum with factory applied corrosion resistant coating or NEMA 4X and UL listed or FM Approved for the Hazardous Area

2.2 NAMEPLATES

A. Provide nameplates for all field mounted instrument, analyzer, or equipment specified in Division 40. Include the equipment or instrument loop title and the instrument or equipment tag number on the nameplate, where nameplate engraving is not specified or shown. Provide machine engraved black phenolic nameplates with white 5/32-inch high lettering, as minimum, unless otherwise specified or shown. Nameplate wording may be changed without additional cost or time, if changes are made prior to commencement of engraving.

B. Attach nameplates to support hardware with a minimum of two self-tapping type 316 stainless steel screws in a readily visible location so the nameplate will remain to identify the service when the device is removed. Attach field instrument nameplates with braided stainless steel straps where not stand mounted.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Install equipment in locations that are accessible for operation and maintenance services. Equipment not accessible shall be reinstalled at no cost to the Owner.
2. Installation, calibration, settings, and testing procedures are specified in Section 40 90 01, Section 40 96 20 – Instrument Index, Part 3 Execution, and subsequent sections of Division 40.

B. Field Equipment

1. Provide equipment with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 48 inches and 60 inches above the floor or permanent work platform. Mount equipment to avoid shock or vibration that may impair operation. Mount equipment for unobstructed access and walkways. Do not attach equipment support systems to handrails, process piping or mechanical equipment.
2. Space instruments and cabinets supported by concrete walls 5/8-inch from the wall by using framing channel between instrument or cabinet and wall. For block walls, provide additional supports, as required, to avoid damage to the wall. Use equipment supports that are hot-dip galvanized after fabrication or 316L stainless steel, as shown or specified.
3. Design support systems including panels to prevent deformation greater than 1/8-inch in any direction under the attached equipment load and under an external load of 200 pounds.
4. In wet or outdoor areas, make conduit penetrations into instrument housing through the bottom (preferred) or side of enclosures to minimize water entry from around or from inside of conduits. Provide conduit hubs for connections and waterproof mastic for moisture sealant.

5. Provide nameplates for all field mounted equipment. Attach nameplates to support hardware with a minimum of two self-tapping Type 316 stainless steel screws in a readily visible location, but such that if the field device is changed out, the nameplate will remain to identify the service.

C. Electrical Power Connections

1. Provide equipment electric power wiring that complies with Division 26. Provide power disconnect switches within sight of equipment and labeled to indicate the specific equipment served and the power source location. "Within sight of" is defined as having an unobstructed view from the equipment served and within 50 feet of the equipment served.
2. Mount equipment power disconnect switches between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location requirements cannot be met by a single disconnect switch, provide two disconnect switches: one at the equipment and one at the work platform.
3. Provide a surge arrestor on each 120 volt AC disconnect switch serving equipment located outdoors. Surge arrestor shall be Telematic, LP Series or equal.

D. Signal Connections

1. Make equipment electric signal connections on terminal blocks or by locking plug and receptacle assemblies. Use flexible cable, receptacle and plug assemblies where shown or specified.
2. Use jacketed flexible conduit between equipment and rigid raceway systems. Flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 2 feet except where sufficient length is required to allow withdrawal of instruments for maintenance or calibration without disconnection of conduit or cord assemblies.

3.2 FIELD TESTS AND INSPECTIONS

A. Delivery Inspection

1. Notify the Owner's Representative upon arrival of any material or equipment to be incorporated into the work. Remove protective covers or otherwise provide access in order that the Owner's Representative may inspect such items.

B. Inspection and Installed Tests

1. Refer to Section 40 98 00 – Process Instrumentation and Control Testing.

3.3 ATTACHMENTS

A. Attachments listed below, following "END OF SECTION," are a part of this Specification:

Form No.	Title
40 90 01-A	Loop Wiring and Insulation Resistance Test Data Form
40 90 01-B	Control Circuit Piping Leak Test Form
40 90 01-C	Controller Calibration Test Data Form
40 90 01-D	Panel Indicator Calibration Test Data Form
40 90 01-E	Recorder Calibration Test Data Form
40 90 01-F	Signal Trip Calibration Test Data Form
40 90 01-G	Field Switch Calibration Test Data Form
40 90 01-H	Transmitter Calibration Test Data Form
40 90 01-I	Miscellaneous Instrument Calibration Test Data Form
40 90 01-J	Individual Loop Test Data Form
40 90 01-K	Loop Commissioning Test Data Form

END OF SECTION

40 90 01-A. LOOP WIRING AND INSULATION RESISTANCE TEST DATA FORM

Loop No.: _____

List all wiring associated with a loop in table below. Make applicable measurements as indicated after disconnecting wiring.

Wire No.	Panel Tie	Field TB	Continuity Resistance[a]		Insulation Resistance[b]			
			Cond./ Cond.	Cond./ Shield	Shield/ Gnd.	Shield/ Cond.	Cond./ Gnd.	Shield/ Shield
A			--	(A/SH)				
B			(A/B)	--				
C			(A/C)	--				
D			(A/D)	--				
etc.								

NOTES:

a. Continuity Test. Connect ohmmeter leads between wires A and B and jumper opposite ends together. Record resistance in table. Repeat procedure between A and C, A and D, etc. Any deviation of ±2 ohms between any reading and the average of a particular run indicates a poor conductor, and corrective action shall be taken before continuing with the loop test.

b. Insulation Test. Connect one end of a 500 volt megger to the panel ground bus and the other sequentially to each completely disconnected wire and shield. Test the insulation resistance and record each reading.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-B. CONTROL CIRCUIT PIPING LEAK TEST FORM

Loop No.:_____

List tubing associated with loop in table below. Make applicable measurements after isolating any air consuming pilots from circuit.

Tube No.	Tubing Equivalent Length of ¼-Inch Copper[a]	Test Period (seconds)	Permitted Pressure Drop (psi)[b]	Measured Pressure Drop (psi)
A				
B				
C				
D				
etc.				

NOTES:

a. Convert actual tubing and air motor volume to equivalent ¼-inch copper tubing.

b. Pressure drop shall not exceed 1 psi per hundred feet ¼-inch tubing per 5 seconds.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-C. CONTROLLER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Process Variable (PV) Scale: _____

Output: _____ Output Scale: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

Connect output to PV for following tests:

Set Point (SP) Indicator Accuracy			Output Meter Accuracy			Controller Accuracy		
SP	PV Reading	Expected % Dev.	Actual Reading	Expected Reading	Actual % Dev.	Output	Output	% Dev.
(0%)								
(50%)								
(100%)								
% Deviation Allowed:			% Deviation Allowed:			% Deviation Allowed:		

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-D. PANEL INDICATOR CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.:_____ Serial No.:_____

Input: _____

Scale: _____ Range: _____

PV Scale Calibration

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-E. RECORDER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____ Chart: _____

Scale: _____ Range: _____

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-F. SIGNAL TRIP CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Scale: _____ Range: _____

Set Point(s): _____

After setting set point(s), run signal input through entire range and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-G. FIELD SWITCH CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No: _____

Input: _____

Range: _____

Set Point(s): _____

Simulate process variable (flow, pressure, temperature, etc.) and set desired set point(s). Run through entire range of switch and calculate deadband.

Set Point	Incr. Input Trip Point	Decr. Input Trip Point	Calc. Deadband	Required Deadband

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-H. TRANSMITTER CALIBRATION TEST DATA FORM

Tag No. and Description: _____

Make & Model No.: _____ Serial No.: _____

Input: _____

Output: _____

Range: _____ Scale: _____

Simulate process variable (flow, pressure, temperature, etc.) and measure output with appropriate meter.

% of Range	Input	Expected Reading	Actual Reading	% Deviation
0				
50				
100				
			% Deviation Allowed:	

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-I. MISCELLANEOUS INSTRUMENT CALIBRATION TEST DATA FORM

(For instruments not covered by any of the preceding test forms, the Contractor shall create a form containing all necessary information and calibration procedures.)

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-J. INDIVIDUAL LOOP TEST DATA FORM

Loop No.: _____

Description: (Give complete description of loop's function using tag numbers where appropriate.)

P&ID No.: (Attach copy of P&ID)

a. Wiring tested:
(Attach test form 40 90 01-A)

b. Instrumentation tubing/piping tested:
(Attach test form 40 90 01-B)

c. Instruments calibrated:
(Attach test forms 40 90 01-C through I)

d. List step-by-step procedures for testing loop parameters. Test loop with instruments, including transmitters and control valves, connected and functioning. If it is not possible to produce a real process variable, then a simulated signal may be used with the Construction Manager's approval.

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

40 90 01-K. LOOP COMMISSIONING TEST DATA FORM

Loop No.: _____

a. Loop tested:
(Attach test form 40 90 01-J)

b. Controlled or connected equipment tests confirmed:

c. Give complete description of loop's interface with process.

d. With associated equipment and process in operation, provide annotated chart trace of loop response to changes in set points for verification of performance. This chart should demonstrate ¼-amplitude damping as output adjusts to set point change. Show set points, starting and finishing times on chart, as well as any other pertinent data.

Connect 2-pen recorder to process variable (PV) and to controller output. Use 1-inch/second chart speed.

Pen 1 - PV - Connections:

Pen 2 - Output - Connections:

CERTIFIED _____ Date _____
Contractor's Representative

WITNESSED _____ Date _____
Owner's Representative

SECTION 40 94 43

PROGRAMMABLE LOGIC CONTROLLER

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	References
1.3	Submittals
1.4	Quality Assurance
1.5	Warranty
2.1	General
2.2	PLC Schedule
2.3	Programmable Logic Controller - Large
2.4	Programmable Logic Controller - Small
2.5	Programming Software
2.6	Spare Parts
2.7	Control Panel Fabrication
2.8	Ethernet Switch
2.9	Panel Mounted Operator Interface
3.1	Installation
3.2	Field Inspection and Testing
3.3	Training
3.4	PLC Input/Output Summary
3.5	Attachments

B. Scope

1. This Section specifies requirements for small and large programmable logic controllers (PLC) designed to execute discrete and continuous control logic with high reliability in industrial applications and operator interface terminal (OIT). Enclosures and components are specified in Section 40 95 16 – Instrument and Control Panels.
2. All PLCs provided for this project shall comply with the requirements of this Section. PLCs provided with equipment specified in Divisions 23, 26, and 43 are provided by the Equipment Manufacturer. Other PLCs are provided by the Systems Integrator per Section 40 90 01.

3. General requirements shall be as specified in Sections 40 90 01 and 40 95 16. PLC assemblies provided by Equipment Manufacturers may be provided by firms other than the Systems Integrator.

1.2 REFERENCES

A. Reference Standards

1. This Section contains references to the following documents or documents listed in Sections 26 00 01, 40 90 01, and 40 95 16. 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).
3. 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.
4. 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
IEC 61131-3	Programmable Controllers – Part 3: Programming Languages
NEMA IA 2.2	Programmable Controllers – Equipment Requirements and Tests
NEMA IA 2.3	Programmable Controllers – Programming Languages

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Shop Drawings
   a. PLC Input/Output (I/O) loop diagram drawings.
   b. Internal power distribution schematic diagram drawings.
2. Calculations
   a. PLC power supply loading calculations.
3. Test and Evaluation Reports

a. Submit factory acceptance test schedule and forms under Section 40 98 00 per the requirements of this Section.

4. Special Procedure Submittals
   a. 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. A check mark shall denote full compliance with a paragraph as a whole.
   b. 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.
   c. 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.
   d. 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.

B. Closeout Submittals
   1. Operation and Maintenance Data
      a. Manufacturer, Representative, and Supplier contact information.
      b. Manufacturer instruction manuals shall include only the following as applicable to the PLC system:
         1) Safety Precautions.
         2) Environmental Conditions.
         3) Troubleshooting guides and diagnostic techniques.
         4) Component connection diagrams.
         5) Removal and replacement instructions.
      c. Final reviewed submittal.
   2. Warranty Documentation
      a. Submit in accordance with Section 01 78 33.
   3. Record Documentation
      a. As-built drawings with record of switch and jumper settings for all components.
      b. Provide the as-built programmable controller program on a CD, prepared using the software type specified in Part 2. Provide 2 copies. Label the CD to include:

1) Owner's name, facility name, project name and project number as shown on the drawings.
2) "Application Programs For (equipment and/or PLC name)".
3) Programming software name and revision.
4) Supplier name and program revision date.

c. Provide the as-built programmable controller program prepared using the software type specified in Part 2 and per Section 40 90 02.

C. Maintenance Material Submittals

1. Spare Parts

a. List of spare parts to be provided.

1.4 QUALITY ASSURANCE

A. Qualifications

1. System Integrator

a. Responsibilities and qualifications shall be as specified in Section 40 90 01.

B. Preconstruction Testing

1. Submit factory test forms for approval prior to tests.
2. Provide all expenses for one Owner staff member and one Engineer staff member to witness factory testing. Travel shall be during business hours on weekdays.

1.5 WARRANTY

A. Manufacturer Warranty

1. Provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01 78 33.

PART 2 PRODUCTS

2.1 GENERAL

A. Manufacturer

1. The Owner and Engineer require the specified Manufacturer to provide the equipment and/or products to be furnished under this Section. The Owner and Engineer believe the Manufacturer is capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named Manufacturer's standard product will comply with the requirements of this Section.

B. Materials

1. Equipment and/or products shall be new and unused at the time of system assembly.

C. Controller conforming to NEMA IA 2.2 and with required memory and functional capacity to perform specified sequence of operation with scheduled input and output points.

1. RFI/EMI Susceptibility: MIL STD 461B CS02.
2. Showering Arc Test: NEMA Pub No ICS2-230.42.
3. Surge Withstand: ANSI C37.90a.
4. RFI Immunity: IEC 801-3.
5. Ground Continuity: IEC 801-5.
6. Electrostatic Discharge: IEC 801-2.
7. Electromagnetic Field: IEC 61000-4-3.
8. Fast transients: IEC 61000-4-4.

2.2 PLC SCHEDULE

Panel No.	PLC Size	Testing	Spares
LCP-1000	Large	Factory Acceptance	Required
Small Pump Station RTU	Small	Factory Acceptance	Required

2.3 PROGRAMMABLE LOGIC CONTROLLER – LARGE

A. Manufacturer: Allen-Bradley CompactLogix.

B. Controller TUV SIL2 Certified.

C. NEMA IA 2.3 and IEC 61131-3 compliant program editor with program written in Ladder Logic Language. Program to be written using the same type of software as is specified below.

D. Networking Connections: Provide all communication interfaces, network cables, taps, terminators, power supplies, and accessories for a complete operating network.

1. Ethernet/IP.

E. Processor: Serial port dedicated solely for programming use, and battery-backed solid-state RAM memory for storage of the control program. Provide additional serial communications adapters required for other serial interfacing. RAM memory size shall be provided so that 50% is available after program is tested.

F. PLC I/O layout shall conform as closely as possible with the I/O layout table 40 94 43-A provided.

G. Input and Output Modules:

1. Discrete Inputs: 120 Vac, 16 channel.
2. Discrete Outputs: 120 Vac, 16 channel.

3. Analog Inputs: 4-20 mAdc/1-5 Vdc, isolated channel-to-channel, 8 channel.
4. Analog Outputs: 4-20 mAdc, isolated channel-to-channel, 4 channel.
5. Spare Input/Outputs: The greater of a minimum one channel or 15 percent of each type provided per control panel.
6. I/O Chassis spare slots: Minimum [1] per chassis.

H. Power Supplies:

1. NOT USED
2. Processor and I/O Chassis: Single, 120 Vac input.
3. I/O only Chassis: Single, 120 Vac input.

I. Miscellaneous: Provide all cables, taps, terminators, power supplies, and accessories for a complete operating PLC system.

2.4 PROGRAMMABLE LOGIC CONTROLLER – SMALL

A. Manufacturer: Allen-Bradley MicroLogix 1400.

B. NEMA IA 2.3 and IEC 61131-3 compliant program editor with program written in Ladder Logic Language. Program to be written using the same type of software as is specified below.

C. Networking Connections: As shown. Provide all communication interfaces, network cables, taps, terminators, power supplies, and accessories for a complete operating network.

1. Ethernet/IP.

D. Processor: With Ethernet port and serial port dedicated solely for programming use, minimum 200k bytes (8 bit) for IEC 1131 control programs, and 24k words (16 bit) for storage of data in battery-backed RAM memory. Provide additional serial communications adapters required for other serial interfacing. Include real-time clock.

E. Input and Output Modules:

1. Discrete Inputs: 120 Vac, 16 channel.
2. Discrete Outputs: 120 Vac, 16 channel.
3. Analog Inputs: 4-20 mAdc/1-5 Vdc, isolated channel-to-channel, 4 channel.
4. Analog Outputs: 4-20 mAdc, 4 channel.
5. I/O module terminations: By Manufacturer to match module.
6. I/O module interface modules: Provide as necessary including cabling to interface all I/O to processor.
7. Spare Input/Outputs: The greater of a minimum one channel or 15 percent of each type provided per control panel.

F. Power Supplies: 24 Vdc. Refer to Section 40 95 16 for power supply.

G. Miscellaneous: Provide all cables, taps, terminators, power supplies, and accessories for a complete operating PLC system.

2.5 PROGRAMMING SOFTWARE

A. Programmable Logic Controller - Large

1. Manufacturer: Allen-Bradley RSLogix 5000, RSLinx, and network module software.
2. Licenses: Provide 1 License. Request Owner / City licensee information prior to ordering for registration.

B. Programmable Logic Controller - Small

1. Manufacturer: Allen-Bradley RSLogix 500, RSLinx, and network module software.
2. Licenses: Owner has licensed copy for their use.

2.6 SPARE PARTS

A. The following spare parts shall be provided:

1. Programmable Logic Controller:
   a. One of each type processor card
   b. One of each type communication card
   c. One for each ten, minimum of one for each type I/O card
   d. One of each type power supply
   e. One of each type pre-fabricated cable

2.7 CONTROL PANEL FABRICATION

A. Refer to Section 40 95 16.

B. Detail shop drawings showing field connections and any terminal block jumpering required.

C. Terminate all used and spare I/O wiring to terminal blocks.

D. Create wire markers with “to-from” component name, PLC slot/base, or terminal column number and terminal number information identical at each end.

E. Provide terminal blocks for field connections to PLC Discrete Inputs:

1. One fused terminal with LED for each group of 8 inputs, connected to control power.
2. Fused terminal connected to eight terminal blocks to provide power to each field input circuit.
3. One terminal per PLC input.
4. One common terminal for each group of 8 inputs, connected to control power common.

F. Provide terminal blocks for field connections to PLC Discrete Outputs:
   1. One fused terminal with LED for each output, connected to control power.
   2. Provide interposing relay for each solid-state PLC output. Connect output and control power common to relay coil. Provide two terminals for relay contact, normally opened unless otherwise noted.
   3. One common terminal for each output, connected to control power common.

G. Provide terminal blocks for field connections to PLC Analog Inputs:
   1. One fused terminal with LED for each input, connected to +24 Vdc.
   2. Two terminals per PLC input.
   3. One common terminal for each input, connected to 24 Vdc common.
   4. One ground terminal for each input shield, connected to signal ground bus.
   5. Two surge protecting terminals for each field mounted instrument or equipment, grounded to the frame ground bus.

H. Provide terminal blocks for field connections to PLC Analog Outputs:
   1. One fused terminal with LED for each output, connected to +24 Vdc.
   2. Two terminals per PLC output.
   3. One common terminal for each output, connected to 24 Vdc common.
   4. One ground terminal for each output shield, connected to signal ground bus.
   5. Two surge protecting terminals for field mounted equipment, grounded to the frame ground bus.

2.8 ETHERNET SWITCH

A. Provide a network Ethernet switch to provide connectivity as shown on the network diagram. Provide the switch with the following minimum features:
   1. N-TRON 306TX Series, Phoenix Contact, or equal
   2. Rugged Industrial Enclosure
   3. DIN-Rail Mountable
   4. Six (6) 10/100BaseTX RJ-45 ports
   5. Plug and Play configuration
   6. Operating Temperature: 0º C to 60º C (32º F to 140º F)
   7. Operating Relative Humidity: 10% to 90% non-condensing

2.9 PANEL MOUNTED OPERATOR INTERFACE

A. The panel mounted operator interface shall have the following minimum features:
   1. 10-inch Color TFT, Touch Screen display
   2. 640 x 480 resolution

3. 10/100Mbps Ethernet
4. 512mB RAM
5. Touchscreen
6. Keypad
7. NEMA 4X
8. Programming software: provide one license and associated documentation: Factory Talk View Studio Machine Edition.
9. Equipment shall be Panelview Plus 6 1000 with extended features (CAT. NO. 2117P-B10C4A9) as manufactured by Allen Bradley.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Section 40 95 16.

B. Connect input and output devices to the PLC via control panel terminal blocks, not directly to the PLC.

3.2 FIELD INSPECTION AND TESTING

A. Refer to Section 40 95 16.

B. Equipment Manufacturer and Systems Integrator

1. The supplier of each PLC system shall provide a qualified service representative to perform the following:
   a. Inspect the PLC installation including I/O and network systems, hardware configuration switch and jumper settings.
   b. Monitor all PLC system diagnostic indicators, both hardware and software, and certify that the PLC system performance meets or exceeds the Manufacturer's published specifications.
   c. Assist in all testing. The Systems Integrator will provide a minimum of two **[insert the required number of man-weeks]** ___ man-weeks on-site for each PLC I/O rack. Equipment Manufacturers shall provide a minimum of two man-days on-site per equipment assembly.
   d. Modify PLC programs as required.
   e. Certify in writing to the Engineer that the PLC system has been installed and configured in accordance with the Manufacturer's published guidelines. Equipment Manufacturer certification requirements are per the associated equipment Specification.

C. Contractor

1. Investigate and resolve fault or trouble conditions to the satisfaction of the PLC supplier.

3.3 TRAINING

A. Operations and Troubleshooting

1. The Systems Integrator shall conduct application program maintenance, modification, and re-loading training. A minimum of four man-hours on-site including training materials and expenses shall be provided for three maintenance personnel.

2. Equipment Manufacturer training is per the associated equipment Specification.

3.4 PLC INPUT/OUTPUT SUMMARY

A. The Programmable Logic Controller I/O Summary provides a listing of PLC module requirements, and the assigned input/output points for the specified PLC system. The unassigned PLC I/O points shall be tagged as spare. The Programmable Logic Controller I/O Summary is included in Attachment A at the end of this Specification Section.

B. Programmable Logic Controller I/O Summary

1. The Programmable Logic Controller (PLC) I/O Summary provides a listing of the assigned input/output points to the specified PLC system.

2. The detailed assignment of I/O to specific points is provided for information only and will be revised and modified throughout the project. Final assignments shall be coordinated between the Contractor, the System Integrator, and the Owner during Construction.

3. Clarification of Headings:

a. Signal: The signal number consists of a two or three letter prefix (indicating the I/O point function) followed by a number identifying the process loop with which the I/O point is associated.

b. Description: Provides an abbreviated description of the function of the I/O point.

c. Source: Identifies field device that I/O point is connected to.

d. Drawings: Identifies the Drawings on which the I/O point is referenced.

3.5 ATTACHEMENTS

A. The following attachments are included as part of this Specification Section

1. PLC I/O Layout

PLC I/O Layout – Large Pump Station Control Panel (with panelview plus 1000 HMI)

I/O Point	Slot 0 (CPU)	Slot 1 (ENET)	Slot 2 (DI)	Slot 3 (DI)	Slot 4 (DI)	Slot 5 (DI)	Slot 6 (DI)
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
I/O Point	Slot 7 (CPU)	Slot 8 (ENET)	Slot 9 (DI)	Slot 10 (DO) MISC.	Slot 11 (DO)	Slot 12 (DO)	Slot 13 (AI)
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

END OF SECTION 40 94 43

SECTION 40 95 16

INSTRUMENT AND CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	References
1.3	Submittals
1.4	Quality Assurance
1.5	Delivery, Storage, and Handling
1.6	Field Conditions
1.7	Warranty
2.1	Panel Design
2.2	Panel Schedule
2.3	Fabrication
2.4	Heating, Ventilating, and Cooling
2.5	Protection Coating and Finish
2.6	Nameplates
2.7	Panel Features
2.8	Surge Protection
2.9	Panel Grounding
2.10	Panel Drawing Protection
2.11	Direct-Current Power Supplies
2.12	Small Pump Station Control Panels
2.13	Uninterruptible Power System (UPS)
2.14	Spare Parts
3.1	General
3.2	Outdoor Panel Shade Covers
3.3	Panel Power Supply
3.4	Factory Testing
3.5	Field Testing

B. Scope

1. This section specifies requirements for panels for instrument, control, and communication equipment for the Gwinnett County Pump Station Project per the Panel Schedule herein.
2. Provide the instrument, control, and monitoring features indicated on the P&ID and electrical drawings. Arrange panels to separate control and instrument devices from power wiring. Arrange panel for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. Panels for Hazardous (Classified) Locations shall bear the appropriate UL 698A label.
3. Transmitters, Analyzers, signal conditioning modules and other equipment or devices as specified in the other Division 40 sections.
4. Panels that contain programmable logic controllers (PLC) and operator interface stations (OIS) units shall be as indicated in the Panel Schedule. Specific panel devices are specified herein and in Section 26 00 02 – Basic Materials and Methods.
5. PLC and OIS shall comply with the specified products in Division 40. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
6. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.
7. Refer to Local Control Panels - Section 26 00 01 that specifies requirements for manufacturer, vendor, and Contractor provided panels that include motor controllers, combination motor starters, control devices, and logic devices as shown on the electrical drawings.

C. Related Sections

1. Section 01 91 13 specifies Equipment and System Performance and Operational Testing with reference to Contractor's Quality Assurance Manager that is responsible for startup commissioning of system including mechanical, HVAC, electrical, and instrumentation system.
2. Division 26 specifies raceways, conductors, and device requirements.
3. Section 40 90 02 – Control Strategies.
4. Section 40 94 43 specifies Programmable Logic Controller, Operator Interface Stations, and software requirements
5. Section 40 98 00 specifies Instrumentation and Control System Testing.

1.2 REFERENCES

A. Reference Standards

1. This section contains references to the following documents that are 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.
3. 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
EIA RS-310C	Racks, Panels, and Associated Equipment
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data
   a. Marked product literature of all the enclosure electrical devices and components mounted on or within the control panel.
   b. List of miscellaneous items, cables, spare and replenishment parts, and chemicals to be provided, including MSDS information.

2. Shop Drawings
    a. A copy of the contract document Process and Instrumentation diagrams relating to the submitted equipment, with addendum updates that apply to the equipment in this section, marked to show specific changes necessary for the equipment proposed in the submittal. If no changes are required, the drawing or drawings shall be marked "no changes required".
    b. Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.
    c. Marked contract document Control Schematic diagrams related to the submitted equipment.
    d. Marked contract document Control Single Line diagrams related to the submitted equipment.
    e. Dimensioned drawings:
        1) Exterior panel and layout
        2) Interior devices and layout
        3) Door-in-door construction devices, where required
    f. Panel assembly drawings including sections showing clearances between face and rear mounted equipment.
    g. Nameplate engraving schedule:
        1) Indicate engraving by line
        2) Character size
        3) Nameplate size
        4) Panel and equipment tag number and description
    h. Wiring drawings:
        1) Schematic diagrams
        2) Internal wiring diagrams
        3) Connection diagrams
3. Design Submittals
    a. Heat load calculations for each cabinet based on the highest ambient temperature listed in Section 40 90 01 for the area in which the subject panel will be located.
4. Certifications
    a. Manufacturer's certification for the performance of features of the specified equipment that cannot be readily inspected.

5. Special Procedure Submittals
    a. 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. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each requested 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.
    b. Failure to include a copy of the marked-up specification sections, along with justification for requested deviations from the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Closeout Submittals
1. Operation and Maintenance Data
    a. Manufacturer's operation and maintenance information as specified in Section 01 78 23. Include final reviewed submittal and separate record of all final configuration, jumper, and switch settings in the Manual.
    b. Installation and training forms specified in Part 3.
2. Test Results
    a. Test results as specified in Section 40 98 00.

1.4 QUALITY ASSURANCE

A. Certifications
1. Equipment and components shall be Underwriters Laboratory (UL) listed for the purpose per Section 26 00 01 or UL recognized.
2. Provide control panels with factory applied UL 508A labels. Where intrinsic safety barriers are used within a control panel, provide UL 698A factory applied label as required by UL.

B. Factory Testing
1. Prior to shipment, have the manufacturer test the functional operation of the control panel as described in the control description Section 40 98 00.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
1. Ship and protect equipment in accordance with the requirements specified in Section 01 65 00.

B. Storage and Handling Requirements

1. Store and protect equipment in accordance with the requirements specified in Section 01 66 00.

1.6 FIELD CONDITIONS

A. Refer to Section 40 90 01.

1.7 WARRANTY

A. Manufacturer Warranty

1. In addition to the guarantee specified in the General Conditions, provide a one (1) year warranty from the date of acceptance by the Owner and Engineer.

PART 2 PRODUCTS

2.1 PANEL DESIGN

A. General: Panel hardware and software is specified in other Division 40 sections.

B. Control Power Distribution: Use the din-rail power distribution method with fuses and blown fuse indication for panels containing 120-volt powered equipment. Power is restricted to 120 Vac and 24 Vdc.

C. Power Supplies: Panels containing direct current powered instruments or serving as the termination point for transmission loop powered field instruments shall contain direct current power supply system as specified herein.

D. Air Supplies: Provide each panel containing pneumatically operated instruments with a dual service regulator and distribution manifold, and all other devices necessary to perform the functions specified. Provide air distribution and control devices as specified.

E. Electrical Control Devices: Pushbuttons, indicating lights, relays, and similar equipment located in panels specified in this section shall comply with the requirements of Section 26 00 02.

F. Uninterruptible Power Supplies: Panel mounted 120 Vac input and 120 Vac output are specified herein.

G. Mission Communications RTU: Make provisions in the panel for the owner to install a Mission Communications M110 RTU. This device will be installed inside the pump station control panel and be connected to a dedicated high level float.

H. Backup control logic: Pump station control panels shall contain backup hardwired control logic for rudimentary control of the pumps during a failure of the PLC control system. This logic shall be interlocked with the PLC_RUNNING relay. This relay shall disable the backup control logic whenever the relay is energized. Upon the relay becoming de-energized the backup control logic shall be engaged. This logic shall have the ability to run the pumps based on level controls. No pump alternation or pump fault procedure is necessary for this mode as it is an emergency backup. An example of this configuration is shown in the attached pump station control panel documents.

I. Pump Station Control Panels located outside shall be NEMA-4X with a Factory applied white TGIC polyester urethane powder coating electrostatically applied to all outside and inside surfaces.

2.2 PANEL SCHEDULE

	Panel No.	Spec / P&ID	Features *	Enclosure Type	Panel Title	E-Dwgs / Notes
1	LCP-1000	40 95 16 / 100-I-601	1, 2, 3, 5	Indoors: NEMA 12 Outdoors: NEMA-4X, painted white	Pump Station Control Panel	Electrical Building
2	SMALL PUMP STATION RTU	40 95 16 / 100-I-601	1, 2, 3, 5	NEMA-4X, Painted White	Pump Station Control Panel	Outdoors
3						
4						

1* - Programmable Logic Controller (PLC) or Remote I/O devices
2* - Panel mounted Operator Interface Station (OIS)
3* - Hardwired control logic required
4* - Windowed outer door and inner door for displays or devices.
5* - UPS
6* - Fans
7* - Heating
8* - Air Conditioning
9* - Sun/Rain Hood

2.3 FABRICATION

A. General

1. Design panels for the seismic requirements of Section 40 90 01. Brace structures, equipment, and devices to prevent damage from specified forces. Equipment panels shall be capable of operation following a disturbance.
2. Provide nameplates with tag number and equipment description to identify face-mounted instruments. Mount instruments for access to components and ease of removal. Blank off cutouts for future equipment with suitable covers. Identify instrument tag numbers on the panel rear.
3. Face-mounted equipment shall be flush or semi-flush with flat-black escutcheons. Face-mounted instruments that are more than 6 inches deep, weigh more than 10 pounds, or exert more than a 4 ft-lb moment force on the face of the panel shall be supported underneath at the rear by a 1-inch x 1/8-inch thick steel angle.

4. Provide floor stands for panels less than 60 inches high to raise the top of the panel to 60 inches above the floor or work platform. Panels that weigh less than 100 pounds may be wall mounted.
5. Panels with specified requirements including stainless steel or aluminum mounting requirements that are indicated on the project drawings or on the project details take precedence over the panel types or panel features indicated herein.

B. Panel Layout

1. Provide 20 percent spare contiguous sub-panel area for future expansion.
2. Provide minimum of 20 percent spare terminal blocks, with a minimum of 10 analog, discrete, power.
3. Provide minimum of 12 inches clear space from the bottom of the panel to the bottom of the subpanel.

2.4 HEATING, VENTILATING, AND COOLING

A. Provide forced air ventilation for panels where indicated in the Panel Schedule and if the cabinet's heat-load calculations indicate that the interior temperature of the cabinet will exceed 115 degrees-F, under worst case conditions.

B. Ventilation for panel racks shall be venturi fans provided on 5-1/2-inch high-notched panel. Ventilation for consoles shall be similar to that for panel racks except EIA RS-310 mounting is not required. Fans shall be equipped with UL-approved washable filters and provide at least 240 cubic feet per minute (CFM). Fans shall be thermostatically controlled. Noise level at 3 feet from exterior wall and 30 degrees off axis shall not exceed 60 NC units.

C. Provide outdoor panels with thermostatically controlled space heaters. Space heater surface temperature that exceeds 120 degrees F requires an expanded metal guard. Thermostats shall be Honeywell T631B1013, Penn Controls A28AA-4, or equal.

D. Panel air conditioning cooling requirements shall be a cooling system that does not exchange cabinet interior air with ambient air. The cooling system shall be either a closed glycol loop heat exchange system or a CFC-free refrigeration system as required for the specified equipment and instrument complement and ambient temperature conditions.

E. Panel air conditioner shall be NEMA rated based on the installed area environment and the coils shall be Heresite, or equal coated and protected from corrosion.

2.5 PROTECTION COATING AND FINISH

A. Panels located outdoors or located in corrosive areas shall be bottom coated with waterproof coatings.

2.6 NAMEPLATES

A. Identify external door-mounted components and the panel description with plastic nameplates. Provide machine embossed metallic adhesive labels to identify tag number of instruments inside panels. Attach nameplates to panel surfaces, not to instruments.

B. Provide machine engraved laminated black phenolic nameplates with white lettering for panel-mounted equipment. Include the instrument tag number and description in 3/32-inch minimum size lettering on nameplate engraving.

C. Attach the nameplates to the panel with a minimum of two self-tapping 316 stainless steel screws. Provide RTV sealant for nameplates for NEMA-4X stainless steel panels.

D. The nameplate wording may be changed without additional cost or time prior to commencement of engraving. Submit nameplate legend with the panel submittal.

2.7 PANEL FEATURES

A. Interconnection Wiring:

1. Panel Interconnecting Wiring:

a. Panel control wiring: Single conductor stranded copper NFPA No. 70 Type MTW No. 16 AWG minimum, with an exception for factory supplied PLC wiring harnesses that are U.L. approved.

b. Panel instrument wiring: Twisted No. 16 AWG shielded pair or tri conductors.

c. Panel power wiring: Conductors specified in Division 26 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.

d. Support wiring independently of terminations by lacing to panel support structure or by slotted flame retardant plastic wiring channels.

e. Provide wiring channels complying with UL 94, Type V.

f. Wiring channel fill not to exceed 50 percent.

B. Conductor Identification:

1. Tag wiring at terminations with machine printed plastic sleeves with three-part wire numbers for instrument and control panel internal conductors:
   a. Part-1: Prefix of the wire number shall be the instrument loop number or equipment tag number.
   b. Part-2: Code letter and wire colors per the following tables.
   c. Part-3: Number that identifies individual circuit conductor [Rung Number] [Terminal Number].

Code	120 Vac Conductor	Color
L	Power	Black
C	Control	Red
N	Neutral	White
PG	Ground	Green

Code	V dc Conductor	Color
PS	24 Vdc Power	Blue
PS	12 Vdc Power	Violet
S+	Signal (+)	Black
SG	Signal Ground	White
EG	Equipment Ground	Green
FV	Panel Foreign Voltage	Yellow

C. Conductor Installation and Protection

1. Carry power and control wiring in covered channels separate from low voltage signal circuits. Provide an interior steel barrier between AC control devices and the electronic equipment.
2. Provide strap screw type terminal blocks rated for 600 volts. Provide each terminal strip with a unique identifying alphanumeric code at one end and a vinyl-marking strip running the entire length of the terminal strip with a unique number for each terminal. Use 1/8 inch high machine printed numbers.
3. No more than two connections shall be made to one terminal.
4. Wire connectors shall be locking fork tongue or ring tongue insulated crimp type terminals.
5. Terminal blocks shall be;
   a. Buchanan 0621-1
   b. Allen-Bradley 1492-HM1 600 V 30-amperes, finger-safe terminal block.

c. Allen-Bradley 1492-CD3 600 V 35-amperes with #8 screw terminal block for ring or spade terminals.

d. Phoenix Contact, Weidmuller, or engineer approved equal products.

D. Field Wiring

1. Connect field wiring to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel.

E. Fuse and Fuse Holders

1. Fuses for 120 Vac circuits shall have a minimum of 12,000-amperes interrupting capacity and blown fuse indicators.

2. Fuses for 24 Vdc circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 mA loops.

3. Fuses for 24 Vdc circuits shall be 1/2 amp for the power supply to individual instruments.

4. Fuse holders shall be tip-out or draw-out type.

5. Provide Phoenix Contact or engineer approved equal products.

F. Control Power:

1. 120 Vac control power source: Single power source for all control and DC power. Dual power sources, one for control power and one for DC power. Dual power sources, one for PLC and DC power and one for PLC output [and input] control power.

a. Provide control power transformers, as required for the load.

b. Provide direct current power supplies, as required for the load.

c. Provide UPS for PLC and derived loop power as defined above, as required for the load.

G. Panel Power:

1. Panel power source:

a. Provide a 120 Vac circuit for the panel light, receptacle, heating, fan, heat exchanger, or air conditioner cooling load as required.

H. Accessories:

1. Provide GFCI convenience receptacles and fluorescent utility lights in panels greater than 24” high x 24”.

2. Do not power receptacles and utility lights by the UPS, where included.

3. Print pocket.

4. Fold-up shelf of sufficient size, sufficient weight capacity, and the proper angle for supporting a laptop computer.

2.8 SURGE PROTECTION

A. Provide multi-stage, plug-in type surge protectors selected to protect the equipment. Surge protectors shall be removable without changing the impedance of the circuit. Surge protectors product manufactures shall be:

1. Circuit Components Inc: Din Rail SDD-400 Series for Data or Analog Signals.
2. Circuit Components Inc: SPD-Series at the 120 AC incoming power.
3. Joslyn Model 1663-08
4. Taylor 1020FA
5. Phoenix Contact
6. Telematic
7. Edco
8. Or engineer approved equal.

2.9 PANEL GROUNDING

A. Provided two copper ground bars in each panel.

1. Bond one bar (NEC required) to the panel or panel frame or back-plate and to the facility grounding system.
2. Mount the second (signal) ground bar on insulated stand-offs and bond to the panel ground bar only at one point.

B. Bond signal circuits, signal cable shields, and low-voltage DC power supply commons to the signal ground bar.

C. Only ground the field analog wiring shields at the signal ground bar. Test to verify that single ground point at panel signal ground bar.

D. Bond surge protectors and separately derived AC power supplies to the frame ground bar.

E. For panels exceeding 36 inches in width, provide 1/4- by 1-inch copper ground bars extending the entire length of the panel interior at the bottom of the panel.

2.10 PANEL DRAWING PROTECTION

A. Provide wiring diagrams in accordance with Section 01 33 23. Provide a panel-wiring diagram and schematic for each panel in a plastic bag or plastic container to avoid water damage and aging.

2.11 DIRECT-CURRENT POWER SUPPLIES

A. Nominal 24-volt direct-current instrumentation and control power supply:

1. Convection-cooled linear type or switching type.
2. Line regulation: 0.4 percent for line variations from 105 to 132 volts.
3. Load regulation: 0.4 percent for load variations from 0 to full load.

4. Ripple and noise: Not exceed 100 mV peak-to-peak.
5. Hold-up time at maximum load: Not less than 16 milliseconds.
6. Continuous duty from 0 to 50 degrees C at rated load.
7. Output electronically current limited.
8. Over-voltage crowbar shutdown.
9. Output voltage:
    a. Rated 28 Vdc
    b. Adjustable plus or minus 5 percent
    c. Set to provide 26.4 volts to the panel direct current bus.
10. Power Supply: Lambda LZS series, or engineer approved equal.

2.12 SMALL PUMP STATION CONTROL PANELS (PSCP)

A. General Requirements

1. All equipment furnished under this section shall be selected for its superior quality and intended performance. Equipment and materials used shall be subject to review and shall comply with the following requirements.
    a. Unless specified otherwise, electrical power supply to the instrumentation equipment will be unregulated 120 volts ac at the locations noted on the one-line and functional diagrams. All transmitted electronic analog instrument signals shall be 4-20 mA dc, unless noted otherwise, and shall be linear with the measured variable.
    b. Cabinet Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICEA.
    c. PSCP shall include physical barriers inside panel to prevent accidental access between telemetry and pump control areas of the panel.
    d. Control panel shall be fabricated at the system integrator’s panel shop. No field fabrication is allowed.
    e. Cabinet shall be built to UL 508 standards and bear UL listing mark stating “LISTED ENCLOSED INDUSTRIAL CONTROL CABINETS”.

B. Pumps 30HP or Greater

1. Use soft starters with 120 VAC coil control.
2. Have soft stop capability.
3. Include integral bypass contactor.
4. Isolation contactor is not required unless specified by the engineer.
5. Have overload protection capability.
6. Display current.

7. Soft start display shall be remotely mounted on inner door of cabinet, as shown on PS-29A

C. Enclosure

1. Enclosure Type: NEMA 4X.
2. Materials: Type 316 stainless steel.
3. Metal Thickness: 14-gauge, minimum.
4. Doors: Rubber-gasket with continuous hinge. Stainless steel lockable quick-release clamps.
5. Provide a lockable handle on the outside of each door.
6. Size cabinet to allow access around all the instruments for ease of operation and maintenance. Design cabinet to prevent overheating of instruments with an ambient air temperature of 100 degrees Fahrenheit with 100% humidity (noncondensing). Air conditioner units will not be allowed.
7. Include a heater unit with thermostat control for protection of cabinet equipment. Design heater for an ambient air temperature of 10 degrees Fahrenheit with 100% humidity (non-condensing).
8. Control panel shall be a 72”H x 36”W x 18”D NEMA 4X stainless steel enclosure with a single dead front door. The control panel shall be laid out as shown on the included detail PS-29A. If additional space is required to house this equipment the panel depth may be increased or a 72”H x 72”W x 18”D double door configuration may be utilized with the telemetry equipment housed in the left hand door and pump starters and protection equipment behind the right door as shown in Detail PS-29A.
9. Factory applied white TGIC polyester urethane powder coating electrostatically applied to all outside and inside surfaces.
10. Manufacturers: Hoffman Engineering Co., Saginaw, or engineer approved equal

D. Inner Door Indicator Lights

1. As shown on Detail PS-29A, mount the following items on the inner door of the PSCP:
   a. Pump Hand-Off-Auto switch
   b. Pump Run Light (Red)
   c. Pump Failure Light (Amber)
   d. Pump Stop Light (Green)
   e. Flygt MAS unit operator interface (if applicable)
   f. Soft Start operator interface (if applicable)
   g. Pump stations shall have a six digit non-resettable elapsed time meters for each pump to show individual pump running time to the 1/10th of an hour.
   h. Engraved lamicoid nameplate with RTU number and station name.

E. Control Power Transformer

1. Install control power transformer(s) inside the panel in the motor control section. Size the transformer at 125% of the rated load and rated for machine tool service.

F. Cabinet Wiring

1. Provide wiring within cabinets meeting the following requirements:
    a. Wires for AC circuits shall be 600 volt, Type THHN stranded conductor copper and shall be sized for the current to be carried, but not smaller than No. 16 AWG.
    b. Wires for analog signal circuits shall be 300 volt stranded copper and shall be twisted shielded pars not smaller than No. 16 AWG.
    c. Wires for other DC circuits shall be 600 volt, Type THHN stranded copper not smaller than No. 16 AWG.
    d. Wiring shall be numbered and tagged at each termination on both ends.
    e. Wiring for special signals such as communications, digital data and multiplexed signals shall use manufacturer's standard cables.
    f. All control wiring shall be stranded. No solid wire shall be allowed, except that the telemetry may be 22-gauge multi-pair telephone cable.
    g. Restrain by plastic ties or wire management system.
    h. Hinge Wiring: Secure at each end so that bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
    i. Arrange wiring neatly, cut to proper length, and remove surplus wire.
    j. Provide abrasion protection for wire bundles that pass through holes or across edges of sheet metal.
    k. Provide wire labels at both ends of terminated wire.
    l. If cellular communications is deemed to be unavailable, provide one RJ-11 telephone jack in the control panel. Phone wire from telephone interface to jack to be gel filled direct burial cable.

G. Compression Clamp Type Terminals

1. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
2. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
3. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
4. Separate analog and dc circuits by at least 6 inches from ac power and control wiring, except at unavoidable crossover points and at device terminations.
5. Arrange wiring to allow access for testing, removal, and maintenance of circuits and components.

6. Plastic Wire Duct Fill: Do not exceed manufacturer's recommendations.

H. Terminal Blocks

1. Provide sufficient terminations to accommodate both present and future needs. Wire spare PLC module I/O points to their Cabinet's terminal blocks. Provide 300 volt screw clamp compression, dead-front barrier type terminal blocks with current bar providing direct contact with wire between the compression screw and yoke. Provide yoke, current bar and clamping screw constructed of high strength and high conductivity metal. Use yoke that guides all strands of wire into the terminal. Use current bar providing vibration proof connection. Supply terminals that allow connection of wire without any preparation other than stripping. Rail mount individual terminals to create a complete assembly.
2. Provide terminal constructed such that jumpers can be installed with no loss of space on terminal or rail.
3. Size all terminal block components to allow insertion of all necessary wire sizes and types. Supply terminal blocks with marking system allowing the use of UL approved terminal blocks manufactured by Allen Bradley, Cutler Hammer, Phoenix Contacts or engineer approved equal.

I. Grounding

1. Cabinets isolated copper grounding bus for all signal and shield ground connections. This ground bus shall be grounded at a common ground point. The signal grounding system shall meet National Electrical Code requirements.
   a. Ground each analog loop at a single point for the loop. This single point shall be at location of the DC power supply for the loop.
   b. Each analog loop shall have its wire shields connected to ground at a single point for the loop.
   c. Discrete signals between cabinets shall be dry isolated contacts rated for 5 amps continuous at 120 V AC.

J. Network Cables

1. Network cables will be as required for a complete and operational system.

K. Electrical Transient Protection

1. General
   a. Protect all elements of the PSCP against damage due to electrical transients induced in interconnecting lines by lightning and nearby electrical systems. As a minimum, provide surge suppressors at the following:
      1) At any connection at AC power to PSCP.
      2) At the radio transmission line bulkhead entrance.
      3) At analog or digital monitoring or controls (DI, DO and AI).
      4) Output of DC power supply.
      5) Ethernet cables.

2. Suppressor on 120 Vac Power Supply Connections
    a. Construction: First stage high energy metal oxide varistor and second stage bipolar silicon avalanche device separated by series impedance. Grounding wire, stud or terminal provided.
    b. Occurrences: Suppressor tested and rated for a minimum of 50 occurrences of IEEE 587 Category B test waveform.
    c. Clamping voltages: 350 volts or less for first stage, 210 volts or less for second stage.
    d. Response: 5 nanoseconds maximum.
    e. Recovery: Automatic
    f. Continuous operation: 5 amps minimum at 130 volts AC for suppressor on power supply for one (1) 4-wire transmitter or receiver, 20 amps minimum otherwise.
    g. Temperature range: -20 degrees C to + 85 degrees C.
    h. Manufacturers: EDCO HSP-121, Phoenix Contact FSP-1, Schneider Electric TVS120LC, or engineer approved equal.
3. Suppressor on Analog Signal Lines
    a. Construction: First stage high energy metal oxide varistor and second stage bipolar silicon avalanche device separated by series impedance. Grounding wire, stud or terminal provided.
    b. Test waveform: Linear 8 microsecond rise in current from zero amps to a peak current value followed by an exponential decay of current reaching for half the peak value in 20 microseconds.
    c. Surge rating: Suppressor tested and rated for a minimum of 50 occurrences of 2000 amp peak test waveform.
    d. DC clamping voltage: Twenty to forty percent above operating voltage for circuit. Clamping voltage tolerance less than plus or minus 10 percent.
    e. Response: 5 nanoseconds.
    f. Recovery: Automatic.
    g. Maximum loop resistance: 18 ohms per conductor.
    h. Temperature range: -20 degrees C to + 85 degrees C.
    i. Approved vendor EDCO PC-642 or SRA-64 Series or engineer approved equal.
4. Main Service Surge Suppressor
    a. Provide a surge suppressor at the power service entrance installed nippled to the main service disconnect switch. The surge suppressor shall meet UL 1449 as a Type 1 SPD and connected to the line side of the main disconnect. The surge suppressor shall have voltage characteristics to match the power service.

1) The surge suppressor shall be in a NEMA-4X stainless steel enclosure and shall provide line to line, line to neutral, line to ground and neutral to ground protection modes as applicable for the power service.
2) The surge suppressor shall be provided with an integral disconnect separate from the main breaker. Minimum surge current rating shall be 1KA per mode, 200KA per phase per NEMA LS-1. The surge suppression system shall be duty cycle tested to survive 20KV, 20KA, IEEE C62.41 category surge current with less than 5% degradation of clamping voltage. The surge suppressor shall have minimum repetitive surge capacity of 6500 impulses per mode. Status indicating lights and form 'C' dry alarm contacts shall be provided. An event counter display shall be provided.
3) The surge suppressor shall be U.L. listed and labeled under UL1449 and UL1283. Acceptable manufacturers are Liebert, Current Technology, or Innovative Technology.

5. Phase Monitor
   a. Provide a phase monitor in the pump control panel. The pump operation shall be inhibited when an open phase/phase reversal condition is detected. A contact of the phase monitor shall also be wired to the PLC for remote indication of the open phase/phase reversal condition.

L. Cabinet Fabrication
1. Power Distribution within Cabinets
   a. One 120 V AC, 60-Hz feeder circuits.
   b. Make provisions for feeder circuit conduit entry.
   c. Furnish terminal board for termination of wires.
   d. Provide 120 VAC Circuit Breaker in each cabinet for incoming AC Power.
2. Signal Distribution
   a. Within Cabinets: 4 to 20 mA dc signals may be distributed as 1 to 5V dc.
   b. Outside Cabinets: Isolated 4 to 20 mA dc only.
   c. All signal wiring shall be twisted shielded pairs.
3. Signal Switching
   a. Use dry circuit type relays or switches.
   b. No interruption of 4 to 20 mA loops during switching.
   c. Switching Transients in Associated Signal Circuit:
   d. 4 to 20 mA dc Signals: 0.2 mA, maximum.
   e. 1 to 5V dc Signals: 0.05V, maximum.

M. Relays
1. General

a. Relay Mounting: Plug-in type socket.
b. Relay Enclosure: Furnish dust cover.
c. Socket Type: Screw terminal interface with wiring.
d. Socket Mounting: Rail.
e. Provide hold-down clips.

2. Signal Switching Relay
   a. Type: Dry circuit.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10 amps at 28V dc or 120V ac.
   d. Contact Material: Gold or silver.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 0.9 watts (dc), 1 .2VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Seal Type: Hermetically sealed case.
   k. Manufacturer: Potter and Brumfield; Allen Bradley, Siemens or Cutler Hammer or engineer approved equal.
3. Control Circuit Switching Relay, Non-latching
   a. Type: Compact general purpose plug-in.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 240V ac.
   d. Contact Material: Silver cadmium oxide alloy.
   e. Coil Voltage: As noted or shown.
   f. Coil Power: 1.8 watts (dc), 2.7VA (ac).
   g. Expected Mechanical Life: 10,000,000 operations.
   h. Expected Electrical Life at Rated Load: 100,000 operations.
   i. Indication Type: Neon or LED indicator lamp.
   j. Push-to-test button.
   k. Manufacturer and Product: Allen Bradley 700-HC14A1, or engineer approved equal.
4. Control Circuit Switching Relay, Latching
   a. Type: Dual coil mechanical latching relay.
   b. Contact Arrangement: 2 Form C contacts.
   c. Contact Rating: 10A at 28V dc or 120V ac.

d. Contact Material: Silver cadmium oxide alloy.

e. Coil Voltage: As noted or shown.

f. Coil Power: 2.7 watts (dc), 5.3VA (ac).

g. Expected Mechanical Life: 500,000 operations.

h. Expected Electrical Life at Rated Load: 50,000 operations.

i. Manufacturer: Potter and Brumfield, Siemens or Allen Bradley or engineer approved equal.

5. Power Supplies

a. Furnish as required power to instruments requiring external dc power, including two-wire transmitters and dc relays. Regulated dc power supplied for instrument loops shall be provided. Power supplies shall be suitable for an input voltage variation of +/- 10 percent, and the supply output shall be fused or short-circuit protected. Output voltage regulation shall be as required by the equipment supplied.

b. Convert 120V AC, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

c. Provide output over voltage and over current protective devices to protect instruments and power supplies from damage due to power supply or external failure.

d. Enclosures: NEMA 1.

e. Mount such that dissipated heat does not adversely affect other components.

f. Supply indicating-type fuses for each dc supply line to each individual two-wire transmitter and mount so fuses can be easily seen and replaced.

g. Include fused push-to-test circuitry for each push-to-test indicating light.

h. Provide internal cabinet light. Light shall be 100-watt fluorescent bulb and shall be operated by a door switch.

i. Provide service outlet with a breaker protected 120-volt, 15-amp, GFCI duplex receptacle and weatherproof enclosure on the outside of the “mini power center” box or support.

N. Control Equipment

1. The PSCP shall include an Allen Bradley Micrologix 1400 PLC, associated I/O, and a PanelView Plus 600c local operator interface.

2. The County will provide a standard PLC & HMI application program for the pump station PLC and HMI. Contractor will setup the software for the pump station, including configuring device ranges, IP address, motor current range, wet well level, set points and other settings, for a complete and operational PSCP.

3. Allen Bradley Micrologix 1400 PLC (1766-L32AWA)
    a. 20 Digital Inputs, 120 VAC
    b. 12 Digital Outputs, relay outputs
4. Digital Input Module (Allen Bradley 1762-IA8)
    a. 8 Digital Inputs, 120 VAC
5. Analog Input Module (Allen Bradley 1762-IF4)
    a. Inputs 4 differential 4-20 mA
6. Analog Input and Output Module (Allen Bradley 1762-IF2OF2)
    a. Inputs 2 differential 4-20 mA
    b. Outputs 2 single ended 4-20 mA
7. Allen Bradley PanelView Plus 600 Color with keypad and touch screen (2711P-B6C20A)
    a. Screen: 5.5 inch
    b. Combination touch and keypad
    c. Ethernet Communication
    d. RS-232 Communication
    e. Power: 120 VAC
8. Programmable Logic Controller Functional Requirements: PLC Inputs and Outputs (I/O) are shown below. Provide inputs, outputs, functions, or operations required to provide a completely operational system. Note that this list does not show the PLCs diagnostic fault detection points which are nevertheless required.
9. Digital Inputs
    a. DI-1 - Pump 1 Auto Mode (1=Auto, 0=Manual)
    b. DI-2 - Pump 1 Run (1=On, 0=Off)
    c. DI-3 - Pump 1 Fault (1=Fault Alarm, 0=Normal)
    d. DI-4 – Odor Control Run (1=On, 0=Off)
    e. DI-5 - Pump 2 Auto Mode (1=Auto, 0=Manual)
    f. DI-6 - Pump 2 Run (1=On, 0=Off)
    g. DI-7 - Pump 2 Fault (1=Fault Alarm, 0=Normal)
    h. DI-8 – Odor Control Fail (1=Fault Alarm, 0=Normal)
    i. DI-9 - Level Switch High (LSH) (0=Alarm, 1= Normal)
    j. DI-10 - Level Switch Lag Start (LSM3) (0=Alarm, 1= Normal)
    k. DI-11 - Level Switch Lead Start (LSM2) (0=Alarm, 1= Normal)
    l. DI-12 - Level Switch Pump Stop (LSM1) (0=Alarm, 1= Normal)
    m. DI-13 - Level Switch Low (LSL) (0=Alarm, 1= Normal)

n. DI-14 - Phase Loss (0=Alarm, 1= Normal)
o. DI-15 - Generator Auto (1=Auto, 0=Not Auto)
p. DI-16 - Automatic Transfer Switch (0=Generator, 1=Normal)
q. DI-17 - Generator Fault (0=Alarm, 1=Normal)
r. DI-18 – Level Switch High High (LSHH) (0=Alarm, 1=Normal)
s. DI-19 – Combustible Gas Alarm (0= High Alarm, 1=Normal)
t. DI-20 – Cabinet Intrusion
u. DI-21 – Station Intrusion [if available]
v. DI-22 – UPS On
w. DI-23 – UPS Fail
x. DI-24 – Generator Run Status (1=On, 0=Off)
y. DI-25 - Spare
z. DI-26 - Spare
aa. DI-27 - Spare
bb. DI-28 - Spare

10. Digital Outputs
    a. DO -1 – Pump 1 Run (1= On, 0=Off)
    b. DO -2 – Pump 2 Run (1= On, 0=Off)
    c. DO -3 – Chemical Feed Pump 1 (1= On, 0=Off) [if available]
    d. DO -4 – Chemical Feed Pump 2 (1= On, 0=Off) [if available]
    e. DO -5 – Odor Control (1= On, 0=Off) [if available]
    f. DO -6 – Pole Lights (1= On, 0=Off) [if available]
    g. DO -7 – Spare
    h. DO -8 – Spare
    i. DO -9 – Spare
    j. DO -10 – Spare
    k. DO -11 – Spare
    l. DO -12 – Spare
11. Analog In
    a. AI – 1 Wet Well Level
    b. AI – 2 Flow Discharge [if available]
    c. AI – 3 Pump 1 Motor Current
    d. AI – 4 Pump 2 Motor Current
    e. AI – 5 Discharge Pressure [if available]
    f. AI – 6 Generator Fuel Level [if available]

g. AI – 7 Combustible Gas Level

h. AI – 8 Spare

12. Analog Out

a. AO – 1 Spare

b. AO – 2 Spare

c. AO – 3 Spare

d. AO – 4 Spare

13. The developer's contractor shall provide all PLCs and associated equipment and cables to form a complete and functional controller with SCADA cellular monitoring, control and data logging capability as required for this project

14. Furnish and install all cables for interconnecting all components of the PLC inside the Cabinet. These cables shall include cables to network bridge, power supplies, central processing unit.

15. Furnish all network cables needed to interface all applicable PLCs with network.

2.13 UNINTERRUPTIBLE POWER SYSTEM (UPS)

A. Provide a UPS that is online, computer-grade with electrical isolation including output neutral. Package UPS for panel enclosure mounting using a back-panel bracket or holder:

1. Nominal input voltage: 120Vac.

2. Nominal output voltage: 120Vac.

B. The online UPS system shall be provided with integral sealed no maintenance batteries, sized to provide full capacity backup power for 30 minute minimum at connected load with integral battery charger.

C. The panel supplier shall calculate the required kVA rating at 150 percent of connected load. Submit load calculations, schematic diagrams, and wiring connection diagrams. Provide battery cabling and other required cabling for a complete system.

D. Mount the UPS within the panel on a pedestal or tray with stainless-steel legs to provide space for wire entry and passage.

E. Uninterruptible power supply systems shall be as manufactured by Best Power Technology, Inc., Necedah, American Power Conversion, Wisconsin, or equal.

2.14 SPARE PARTS

A. Provide the following spare parts:

1. Ten each of each type of light bulb used in the panels.

2. Five each of each type and rating of fuse used in the panels.

PART 3 EXECUTION

3.1 GENERAL

A. Mount and shim floor mounted cabinets to precise alignment so doors operate without binding. Provide sealant for conduit entering the panels.

B. Mount floor-mounted panels, except in dry control rooms or electrical equipment rooms, on 3-1/2-inch minimum height concrete pads or grouted bases as specified. Provide coating for outdoor panels in contact on concrete. Mount field panels and cabinets in compliance with Section 40 90 01, paragraph 3.1.B.

C. Spray terminals and terminal blocks after all terminations have been completed with a silicone resin similar to Dow Corning R-4-3117 conformal coating.

D. Provide panels with the Record As-built schematic, connection, and interconnection diagrams mounted behind plexiglass holder on the inside of the door. Place documentation in a water proof clear bag in the panel document holder.

3.2 OUTDOOR PANEL SHADE COVERS

A. Fabricate the custom aluminum panel shade cover and mount the panels facing away from the prevailing sun or wind.

B. Provide Sun/Rain covers per Electrical Detail for outdoor vendor, manufacture, and custom panels. Fabricate based upon known panel dimensions or accepted submittal drawing dimensions.

3.3 PANEL POWER SUPPLY

A. Mount and connect power supply and conditioning equipment in compliance with the manufacturer's instructions.

B. Provide line side disconnect switches for power supply and conditioning equipment. Provide line and load side overcurrent protection for power supply and conditioning equipment in compliance with NFPA 70. Disconnect switches shall comply with Section 26 00 02.

C. Small power supply and conditioning equipment may be mounted in the panel served. Mount larger units adjacent to the equipment served. Where unconditioned power is brought into control panels, enclose it in metallic raceways within the panel.

D. Provide sound isolators for power supply and conditioning equipment larger than 5 kVA load capacity supported from surfaces other than concrete.

E. Use flexible conduit in compliance with Division 26 for final raceway connections.

3.4 FACTORY TESTING

A. Assemble, interconnect, and functionally test the control panel at the assembly shop prior to shipment. The Owner/Engineer shall have the option of witnessing the functional shop test. Notify the Owner/Engineer at least two (2) weeks in advance prior of the scheduled functional shop test.

3.5 FIELD TESTING

A. Field verify the following for Instrument and Control Panels:

1. Control circuits grounded with one terminal of each load device connected to the grounded conductor.
2. Control contacts installed in the ungrounded side of the circuit.
3. Signal and control wiring installed in separate wireways.
4. Barriers between the power wiring and the signal and control wiring.
5. Connected to the plant grounding system, as specified.
6. Center-line of wall-mounted panels shall be 48 inches above the floor.
7. Inner door contains a copy of the Record elementary and wiring diagrams.
8. Inner door contains a protected drawing holder.
9. Drawings enclosed in a transparent, protective jacket.
10. Functions as specified.
11. Mounted with stainless steel unistrut, fittings, and fasteners.
12. Tested in accordance with Section 26 00 01 and Section 40 98 00.

END OF SECTION 40 95 16

SECTION 40 95 51

TRANSMITTERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
1.3	Quality Assurance
1.4	Warranty
2.1	General
2.2	Process Parameter Output Indicator
2.3	Intrinsic Safety Barriers
2.4	Instrument Specification Sheets (Instruspec)
2.5	Signal Current Isolator
3.1	Installation
3.2	Testing
3.3	Instrument Specification Sheet (Instruspec)
3.4	Instrument Specification Sheet - Instruspec
3.5	Instrument Specification Sheet - Instruspec
3.6	Instrument Specification Sheet - Instruspec
3.7	Instrument Specification Sheet - Instruspec
3.8	Instrument Specification Sheet - Instruspec
3.9	Instrument Specification Sheet - Instruspec

B. Scope

1. This section specifies requirements for process parameter transmitters, associated indication devices, and accessories.
2. The application requirements are specified in the Instrument Index - Section 40 96 20.

1.2 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data
   a. Marked product literature of all equipment and features to be provided.
   b. List of miscellaneous items, cables, spare parts, that will be provided in accordance with INSTRUSPEC sheet requirements.
   c. Marked product literature for surge protectors.
2. Shop Drawings

a. Marked Contract Document Mechanical and/or Electrical Plan drawings, sections, and details showing sensor installation locations and details. *Failure to include copies of the relevant drawings with the submittal shall be cause for rejection of the entire submittal with no further review.*

b. Installation drawings for only the transmitters, sensors, and mounting accessories to be provided.

c. Electrical and signal connection drawings for only the transmitters and sensors to be provided.

3. Special Procedure Submittals

a. 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. Referenced and applicable sections to be marked up and submitted include:

1) Section 01 78 23 – Operating and Maintenance Data

2) Section 40 90 01 – General Requirements for Instrumentation and Control

3) Section 40 96 20 – Instrument Index

b. A check mark 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.*

B. Closeout Submittals

1. Operation and Maintenance Data

a. Operating and maintenance information as specified in paragraph 40 90 01-1.4.B. Include final reviewed submittal and separate record of all final configuration, jumper, and switch settings for each transmitter.

2. Test Results

a. Test results as specified in Section 40 98 00.

1.3 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers

a. Equipment furnished under this section shall be the products of firms regularly engaged in the design and manufacture of such equipment for a minimum of five years.

2. Installers

a. Installation, calibration and testing of equipment furnished under this section shall be performed by qualified, skilled, Certified Technicians specified in Section 40 90 01, who are regularly engaged in such activities involving systems of similar complexity.

1.4 WARRANTY

A. Manufacturer Warranty

1. In addition to the guarantee specified in the General Conditions, provide a one (1) year warranty from the date of acceptance by the Owner and Engineer.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide measuring elements and transmitters in compliance with the following requirements:

1. Provide measured parameter output indicators complying with paragraph 40 95 51-2.2 with any transmitter that does not include an integral indicator. Calibrate indicators, whether integral or separate, in process units, and engrave on the indicator scale plate.
2. For two-wire type transmitters derive operating power from the signal transmission circuit.
3. Provide transmitters meeting specified performance requirements with load variations within the range of 0 to 600 with the power supply at a nominal 24 volts DC with the default range of 0 to 100% corresponding to 4 to 20 madc.
4. Transmitter output shall increase with increasing measurement.
5. Time constant shall be adjustable from 0.5 to 5.0 seconds for transmitters used for flow, level transmitters used for flow measurement, or pressure measurement.
6. Galvanically isolate transmitter output via electro-mechanical or optical technology.
7. Provide transmitter enclosures that are rated NEMA 250, Type 4, unless otherwise specified.
8. Provide transmitters and analyzers located outdoors with surge protectors:
   a. Signal: Emerson/Rosemount Model 470 D, Emerson/EDCO SS64-036-2, CCI SPN-42 FS28 Series, or engineer approved equal.
   b. AC Power: UL 1449, LED indicator, screw terminal connections, NEMA 4X. EDCO HSP121A or engineer approved equal.
9. Make two-wire transmitter located in a facility area classified as hazardous per the NFPA and the NEC safe by means of an intrinsic safety barrier as specified in paragraph 40 95 51-2.3.
10. Isolate four-wire transmitters from the process and power or provide with a loop-powered signal current isolator as specified in paragraph 40 95 51-2.5 connected in the output signal circuit.

2.2 PROCESS PARAMETER OUTPUT INDICATOR

A. Provide digital LED or LCD indicators that are integral to the instrument housing where available from the manufacturer. Displays shall be scaled in engineering units, over the calibrated range of the instrument. Calibrate the indicator scale in process units.

B. Analog output indicators shall be 2.5-inch milli-ammeter with 90-degree movement enclosed in a NEMA 7/9 rated meter case. Provide indicators with accuracy within two percent of span. Provide a diode to maintain loop continuity for indicator removal.

2.3 INTRINSIC SAFETY BARRIERS

A. Intrinsic safety barriers for two-wire transmitters shall be of the active, isolating, loop powered type. Barrier shall be Measurement Technology LTD Type MT3042, Stahl Series 9000, or engineer approved equal.

2.4 INSTRUMENTATION SPECIFICATION SHEETS (INSTRUSPEC)

A. General requirements for instruments specified in this section are listed on INSTRUSPEC sheets in paragraph 40 95 51-3.3 through 3.9.

B. Application requirements are specified in the Instrument Index, paragraph 40 96 20-3.3, and/or on the drawings.

2.5 SIGNAL CURRENT ISOLATOR

A. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters. House isolator in a NEMA 250, Type 4/7 conduit body and derive operating power from the signal input circuit.

B. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms.

C. Isolator shall be Moore Industries SCX 4-20madc to 4-20madc / 5.5VPL / -RF [DIN rail mounted with maximum 250 ohm output impedance, or engineer approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation requirements are specified in Section 40 90 01.

3.2 TESTING

A. Testing requirements are specified in Section 40 98 00.

3.3 INSTRUMENT SPECIFICATION SHEETS (INSTRUSPEC)

A. General requirements for instruments specified in this section are listed on INSTRUSPEC sheets herein. Application requirements are specified in the Instrument Index, paragraph 40 96 20-3.3, and/or on the drawings. INSTRUSPEC sheets for the transmitters listed in the following Table A are included in this paragraph:

Table A: Process Monitors and Indicating Transmitters

INSTRUSPEC Symbol	Instrument Description	Instrument Function
FM	Magnetic Flow Transmitter	Flow Measurement
LUT	Ultrasonic Level Transmitter	Level Measurement
PGT	Gage Pressure Transmitter	Pressure Measurement

3.4 INSTRUMENT SPECIFICATION SHEET--INSTRUSPEC

Instrument Identification:	FM
Instrument Function:	Flow Measurement
Instrument Description:	Magnetic Flow Metering System
Signal Input:	Process
Signal Output:	Analog signal as specified in paragraph 40 95 51-2.1 HART Protocol
Process Connection:	Flange, ANSI B16.5, Class 150, raised face.
Product Requirements:	Magnetic flow meter provided as a system consisting of a flow tube with separate or integral converter / indicating transmitter, as scheduled in the Section 40 96 20 Instrument Index, complete with interconnecting cables Remote mounted indicating transmitter for full-scale flow rates from 1.0 to 30 feet per second. System error shall not exceed the greater of 0.5 percent of flowrate or 0.1 foot per second from 3 to 30 feet per second.
Flow Tube:	Flow tubes manufacturer shall provide grounding rings fabricated from the same metal as for the electrodes below. Flow tube sizes below 2 inches may be wafer-style ductile-iron or full-body flanged construction. Electrodes: 316L stainless steel unless otherwise specified in Section 40 96 20. Liner: Polyurethane unless otherwise specified in Section 40 96 20.
Transmitter:	Contain electronics associated with the magnetic flow meter system. Enclosure rating NEMA-4, cast aluminum or metal compartment for power, field connections and calibration adjustments separate from digital circuitry. Means to calibrate the metering system without use of external calibration units. Transmitter self-diagnostics. Traceability certificate of actual flow lab certification provided with each flow tube. Integral 4-digit LCD flow indication calibrated in process units. Data retained in non-volatile memory.

Internal circuitry to drive flow signal to zero upon flow meter determined empty pipe condition.

Execution:

Installation: Install in accordance with manufacturer's instructions and the specified functional requirements.

Cable: Signal cable between the flow tube and transmitter provided by the system manufacturer with sufficient length of cable for continuous installation between the flow tube and the transmitter.

Manufacturers:

ABB Magmaster MFE
Endress + Hauser Promag 50W/53W
Krohne Optiflux 4000
Accepted equal.

3.5 INSTRUMENT SPECIFICATION SHEET—INSTRUSPEC

Instrument Identification:	LUT
Instrument Function:	Level Measurement
Instrument Description:	Ultrasonic Level Transmitter
Power Supply:	120 Vac, 60-Hertz nominal or 24 Vdc Loop Powered as specified in 40 96 20 Instrument Index
Signal Input	Process
Signal Output:	As specified in paragraph 40 95 51-2.1
Process Connection:	As shown or specified

Signal Converter / Indicating Transmitter:

Processor: Selectable algorithms for level, volume, or flow.
Flow: Parshall Flume, Weir, or configurable flow device.

Indicator: 4-digit LCD with 0.50-inch display, scaled in engineering units.
Accuracy: 0.25% of level range.
Analog Outputs: Two 4-20 mA into a minimum of 600Ω.
Discrete Outputs: Two Form-C rated at 5A, 250 Vac.

Enclosure**:** NEMA 4X wall mount

Accessories:
Mounting hardware and cable glands.
Removable Handheld infrared programming device
Programming software and cable length as required.

Acceptable Manufacturer:
Milltronics Hydroranger 200.
Central Station Steam CPS Series.
Endress Hauser
Accepted equal.

Sensor:

Measuring range: 1 to 33 feet
Beam Angle: 6°
Pressure Limit: 30 psi
Temperature Limits: -40 to +175°F.
Wetted Materials: PVDF
Cable: #16 to #20 TSP with PVC jacket
Maximum Sensor/Transmitter Separation: 1200 ft.
Rating: Class I, Div. 1, Groups A, B, C & D.

Execution:

Installation:	Install in accordance with manufacturer's instructions and the Engineer’s installation detail. Contractor to verify size and type of specified tank connection with approved tank submittals. Transducer rigidly mounted approximately two feet above maximum liquid level and accurately leveled. Transmitter wall or stand mounted as specified.
Calibration:	System calibrated in accordance with Section 40 96 20.

3.6 INSTRUMENT SPECIFICATION SHEET—INSTRUSPEC

Instrument Identification:	PDT
Instrument Function:	Pressure Measurement
Instrument Description:	Differential Pressure Transmitter
Power Supply:	As specified in paragraph 40 95 51-2.1
Signal Input:	Process
Signal Output:	Analog transmission signal as specified in paragraph 40 95 51-2.1
Process Connection:	Two 1/2-inch female NPT flange adapters
Product Requirements:	Pressure Transmitter: Capacitance or piezoresistive type. Wetted Parts: Type 316 stainless steel or as specified in Section 40 96 20 Instrument Index. Range: 100:1. HART standard data communication protocol. Accuracy: 0.075 percent of calibrated span. Static Pressure Rating: 2,000 psi Indicator: LCD display. Acceptable Manufacturer: Rosemount 3051CD. Central Station Steam CPLD Series. Endress Hauser Accepted equal.

Execution

Installation:	Install in accordance with manufacturer's instructions and the Engineer’s installation detail. Root valves provided at all process pressure taps. Gauge valves provided at the instrument where the instrument is not within sight of the root valve or where two or more instruments are connected to a single tap. Safety instruments shall not be connected to the same process tap as instruments used for control, indication, or recording. Pressure instruments located as close as practical to the process tap and be positioned to permit observation and maintenance. Pressure instruments shall not be supported from process piping.

Pressure instruments for use with integral seals, or remote seals and capillary tubing provided by a single manufacturer with components factory-assembled prior to shipping.

Seals:

Type: Diaphragm

Process Connection: 3-1/2-inch saddle style, pancake, or flush flanged as required by the application.

Diaphragm and Wetted Parts: Type 316L stainless steel unless otherwise specified in Section 40 96 20.

Upper Housing and Mounting Flange: Type 316L stainless steel.
Lower Housing: Type 316 stainless steel

Temperature Limit, High Side: -40 to 300 degrees F

Acceptable Manufacturer:
Rosemount 1199.
Accepted equal.

Capillary Option:

Seal Location: High pressure side of transmitter, direct mounting

Fill Fluid: DC 200 Silicone

Capillary Seal Connection Material: Type 316 stainless steel armored sleeving

END OF SECTION

SECTION 40 96 20

INSTRUMENT INDEX

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Submittals
2.1	Instrument Index
3.1	General Requirements
3.2	Installed Equipment – Tests and Inspection
3.3	Instrument Index

B. Scope

1. This section specifies the Instrument Index and general requirements applicable to process instrumentation and analyzer systems consisting of process sensors, process indicators, signal conditioning module, control and monitoring devices, transmitters, and accessories.
2. Provide, calibrate, and test the complete process instrumentation and analyzer systems and place in operation and test the system. Testing includes tuning loops and making final adjustments to instruments and analyzers during facility start-up.
3. Provide the services of certified instrument technicians for testing and adjustment activities as specified in Section 40 90 01.
4. Examine the mechanical drawings and specifications to determine actual locations, sizes, materials and ratings of process connections. Indicate process taps on pipe shop drawings.

C. Related Requirements

1. Section 40 90 01 – General Requirements for Instrumentation and Control.
2. Section 40 98 00 – Process Instrumentation and Control System Testing

1.2 SUBMITTALS

A. Refer to Sections 40 90 01 and 40 98 00.

PART 2 PRODUCTS

2.1 INSTRUMENT INDEX

A. The Instrument Index, paragraph 40 96 20-3.3, lists instruments and analyzers required for the project. Instrument functions specified on this list shall be provided by the Contractor.

B. Additional instrumentation devices such as process taps, seals, and other items required to complete the instrument loops due to characteristics of the equipment selected by the Contractor and not specified in the instrument index or on the contract drawings shall be provided at no additional cost to provide a complete working system.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Materials, equipment, and installation shall be tested and inspected per Sections 40 90 01, 40 98 00, and this section.

B. Provide buffer solutions and reference fluids for analytical equipment test procedures.

3.2 INSTALLED EQUIPMENT – TESTS AND INSPECTION

A. Refer to Section 40 98 00 – Process Instrumentation and Control Testing

3.3 INSTRUMENT INDEX

A. The following is an index of the instrumentation equipment, analyzers, and devices.

B. Description of Headings:

1. Tag Number:
    a. Tag Number appears as a heading (Prefix and Number) and consists of a two, three or four letter prefix indicating the instrument function followed by a number identifying the process loop with which the instrument is associated. Tag Number provides an identification of the instrument, analyzer, or device.
2. Description:
    a. Provides the functional description of the instrument, analyzer, or device.
3. P&ID Number:
    a. Lists the Process and Instrumentation Diagram on which the instrument, analyzer, or device appears.
4. Specification:
    a. Provides the specification reference and “INSTRUSPEC” designation for the instrument, analyzer, or device.
5. Size:
    a. Provides the application data relative to sizing the instrument; flow tube diameter, probe length, associated pipe sizes, etc.
6. Range:
    a. Provides the calibrated instrument range for each application.
7. Set Point:
    a. Provides the calibrated switch set point.
8. Comments:
    a. Provides the features, interlocks, and information applicable to the instrument, analyzer, or device.

INSTRUMENT INDEX

TAG NO.	DESCRIPTION	P&ID	SPEC	SIZE	RANGE	SETPOINT	COMMENTS
FM-701	MAGNETIC FLOW METER	I-101	40 95 51	12”	0 – 5,000 gpm		
LE-301	6.0 MG CLEARWELL LEVEL SENSOR	I-101	40 95 51	NA	0 – 40 ft		

END OF SECTION

SECTION 40 96 35

PROCESS CONTROL SYSTEM DEVELOPMENT AND PROGRAMMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Administrative Requirements
1.3	Submittals
3.1	Process Control System Implementation Plan
3.2	Tag Database Development
3.3	Graphical Operator Interface Development
3.4	Process Control Logic Development
3.5	On-line Help
3.6	Historical Data Management System
3.5	Testing and Commissioning

B. Scope

1. This section specifies the general requirements applicable to the development and programming of the process control system graphical operator interface, historical data management system, and process control logic.
2. The Owner will provide the system integrator with an example PLC and OIT program of a similarly configured pump station. The system integrator will use this program to begin their software development. This example is to be used as a guideline for the style of graphics, navigation, and logic programming. This guideline has been used throughout the owner's automation system.
3. The system integrator shall provide programming of the pump station PLC, OIT, and other automated control systems at the pump station. The Owner will provide programming of the SCADA system at their central facility. The system integrator shall coordinate programming information with the Owner or the Owner's Contractor to facilitate this SCADA programming.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Implementation Plan Meetings

1. The Systems Integrator shall include as work of this section of the specifications the requirement for two (2) meetings to be held at the project site. The primary function of the meetings is to solicit input from the Owner regarding the implementation of the process control system and to facilitate preparation of the Process Control System Implementation Plan specified herein.

2. The Systems Integrator shall have in attendance at each meeting a representative who is responsible for the preparation of the Process Control System Implementation Plan. The preliminary schedule and agenda for each of the meetings shall be as described below. The specific dates for each of the meetings shall be scheduled by the Systems Integrator and approved by the Engineer.
3. The Engineer shall be provided with two (2) weeks minimum advanced written notice of proposed scheduled meeting dates. The System Integrator shall prepare a detailed meeting agenda and submit it to the Construction Manager with the notice of proposed scheduled meeting dates.
    a. Conduct Meeting-1 within sixty (60) days of receipt of Notice to Proceed. The purpose of this meeting is to begin preparation of the Process Control System Implementation Plan. The System Integrator shall be prepared to present the capabilities of the proposed process control system software and the alternatives available for each of the major areas of implementation described by the Process Control System Implementation Plan.
    b. Conduct Meeting-2 within thirty (30) days of completion of the Engineer's review of the Process Control System Implementation Plan submittal. The purpose of this meeting is to discuss the submittal review comments and resolve any related issues.

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals
    1. Special Procedure Submittals
        a. Process Control System Implementation Plan
B. Closeout Submittals
    1. Record Documentation
        a. Process Control System Developer's Guidelines
            1) Modify and update the Process Control System Implementation Plan during the course of development of the process control system control logic and graphical operator interface to reflect the conventions and standards used in the final system development. Upon final acceptance of the work, re-publish and submit the updated implementation plan as the Process Control System Developer's Guidelines.
        b. Process Control System Configuration Report
            1) Report documenting the final configuration of the process control system including the following:
                a) Hardware Configuration: Document final switch settings and jumper positions for all process control system components including processors, communications adapter modules, motor controllers and adjustable frequency drives, power metering systems, etc.

b) Process Control Logic: Bound hard copy of the annotated process controller program listing. The program listing for each processor shall be separately bound and shall have tab dividers for each program file listing. Program listing shall include cross references.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PROCESS CONTROL SYSTEM IMPLEMENTATION PLAN

A. General

1. The Systems Integrator shall prepare an implementation plan for the process control system development and programming work. The implementation plan shall establish guidelines for development of the graphical operator interface, the historical data management system and the programmable logic controller (PLC) process control logic and shall insure the consistent application of conventions and methods through the course of development. The implementation plan shall specifically address the following:

   a. Tag database structure and configuration.

   b. Tag naming conventions.

   c. Graphical operator interface standards.

   d. Process control system configuration.

   e. PLC program file organization.

   f. PLC data file organization.

   g. List and description of graphic displays.

B. Tag Database Structure and Configuration

1. The implementation plan shall define how the tag database will be organized to logically associate tags with specific input/output types, functions, or process areas. In addition, the plan shall prescribe guidelines for configuration of tag alarm handling and annunciation and tag data logging.

C. Tag Naming Conventions

1. Establish a tag naming convention which provides a structured organization to the tag database facilitating tag searches and substitutions during system development and provides for effective and efficient design, management and operation of the process control system. Develop the tag naming convention to take full advantage of the capabilities of the process control system software and not impose any artificial constraints in the operation or management of the process control system. At a minimum, comprise tag names of the following information:

   a. Equipment type designation.

   b. Equipment loop number.

   c. Signal type designation.

D. Graphical Operator Interface Standards

1. Base the configuration and development of the graphical operator interface on standards prepared specifically for this application. Consistently apply the interface standards to the development of the interface to insure optimum usability.
2. Implement all HMI development including tag naming scheme, screen navigation methods, use of pop-ups, etc. in a manner that is consistent with HMI systems in use elsewhere in the Owner's existing operations at other facilities. Utilize the same colors, symbols, fonts, and features on graphic screens to provide an interface to operators that is uniform and consistent with existing HMI screens serving Owner's other facilities.
3. The interface standards shall specifically address the following topics:
    a. Graphical Display Type: The user interface will be comprised of various types of graphic displays including schematic overviews, control panels, faceplates, utility displays, and trend displays. The content and layout of each type of interface including navigational and utility features shall be defined by the standard. The standard shall also define the naming conventions for graphic display files.
    b. Symbology: The symbology used in the preparation of the graphical interface shall be defined by this standard. The symbology standard shall address the following symbol types:
        1) Symbols representing process equipment, structures, piping, and systems.
        2) Navigational and utility system icons.
        3) Dynamic data display objects including numeric displays, bar graphs, indicating lights, text labels, etc.
        4) Control objects including pushbuttons, selector switches, slider bars, set point entry, etc.
    c. Colors: The color standard shall define the foreground, background, and border colors used to indicate dynamic conditions (run, stop, alarm, trouble, ready, etc.), process-specific applications (raw water, settled water, finished water, chemicals, etc.), graphic display backgrounds, dynamic data objects, text, control objects, etc.
    d. Visibility: The visibility standard shall define the following:
        1) Application of blinking to graphic objects.
        2) Application of font styles and sizes.
        3) Manipulation of graphic object color to represent different conditions.
    e. Terminology: All terminology used to annotate the graphical interface shall be defined by these standards. The terminology standards shall define the following:

1) Descriptive names used to identify the treatment processes, systems, structures, equipment, process variables, etc.
2) Units of measurement for all process variables.
3) Alarm condition descriptors.
4) Abbreviations.

f. Navigation: The navigation standard shall define the organization of the user interface and the features of the navigational system. This standard shall address all techniques used to implement the navigation system and where and how the navigation system is accessed including button bars, shortcut icons, hot links, continuation labels, and graphic menus.

E. Process Control Logic Configuration

1. Develop guidelines which define the organization and structure of the process control logic and data memory within the process controller. These guidelines shall address the following:
   a. Structure of the control logic including the use of subroutines and the allocation of memory to accommodate modifications and expansion of the control logic.
   b. Methodology for handling common control functions shall be standardized such that similar functions are implemented in a consistent manner across the entire project. Standardized routines for motor control, VFD control, instrument data handling, alarm management, etc. shall be developed and reviewed by the Owner prior to final programming.
   c. Assignment of data storage memory including data formats and method of documenting memory mapping.
   d. Methodology for implementing peer to peer communications including allocation of memory or register addresses is such a way as to organize data for optimum efficiency of data exchanges between peer processors.

F. Process Control Strategies

1. Review process control strategies with the Owner and refinements made as agreed to by the Systems Integrator. Modifications to the control strategies that are determined to be a change in scope will be addressed by change order. Incorporate the final process control strategies into the Implementation Plan.

3.2 TAG DATABASE DEVELOPMENT

A. General

1. The process control system tag database development shall include the definition of all devices, derived and soft tags and the required alarm processing and data logging and archiving definitions for each tag. Conventions used in the development of the tag database shall be as defined in Process Control System Implementation Plan.

B. Tag Definition

1. The definition of tags in the tag database shall comply with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:

   a. Tag Naming Conventions: Tag names shall minimally consist of two distinct components. The leading component shall represent the tag equipment number. The trailing component (tag descriptor) shall be an abbreviated description of the associated process variable or the function of the tag. Assign each component a fixed maximum length which shall be dependent on the available tag name length supported by the process control system software.

   b. The tag equipment number shall be derived from the primary item of process equipment or instrumentation most closely associated with the process variable and shall be comprised of an equipment type prefix followed by process loop number. The equipment numbers shall be as defined by the Contract Documents.

   c. The tag descriptor shall provide a description of the process variable referenced by the tag name or a description of the function associated with the tag. Tag descriptors shall be based on ANSI/ISA-S5.1 and Appendix B of ISA-RP60.6. The tag descriptor may be comprised of several parts to clearly define the tag function. The following typographical convention shall be used to create the tag descriptor:

      1) Symbol identification letters (ANSI/ISA-S5.1) shall be all upper case.

      2) The first letter of an abbreviation (ISA-RP60.6) shall be upper case. The remainder of the abbreviation shall be lower case.

2. Examples of the tag names are provided in Table 3.2.B.2:

Table 3.2.B.2

Tag Name	Tag Function
P1121PSH	Pump P1121 pressure switch high
FIT1101	Flow transmitter 1101
P1121Run	Pump P1121 run status

3. Tag Descriptions: Describe the tag in terminology consistent with this application. Abbreviations and equipment numbers shall be not be used in the tag description without prior approval of the Owner. Tag descriptions shall not include any wording which implies the state or condition of the tag. For example, the tag description for P1121PSH shall read “Backwash Water Pump 1 Discharge Pressure” in lieu of “Backwash Water Pump 1 Discharge Pressure High.”

4. ON/OFF and Alarm State Labels: The ON/OFF and alarm state labels shall consist of words which describe the state of the tag. For digital tags, the logic TRUE state of the tag will generally be the state labeled.

5. Examples of ON/OFF and alarm state labels include RUN, OFF, OPEN, CLOSED, READY, ALARM, NORMAL, HIGH, LOW, HIGH-HIGH, LOW-LOW, etc. Abbreviations shall not be used in ON/OFF or alarm state labels.

C. Tag Types

1. Classify tags as either device tags, derived tags or soft tags.
   a. Device Tags: Tags which have a physical device as the data source.
   b. Derived Tags: Tags whose value is calculated or otherwise derived from another tag. Derived tags have no data source address.
   c. Soft Tags: Tags whose value is obtained from another process software application.
2. Tags shall be defined for each of the following tag data sources:
   a. Physical input/output process variables derived from the process control input/output subsystems. Refer to the Input/Output Summary, paragraph 40 94 43-3.4.
   b. Control and status data derived from the process control logic required to fully implement the process control strategies specified in Section 40 96 20. This data shall include the following types of information:
      1) Operating set points.
      2) Process operations setup and control parameters including start/stop, lead/lag, auto/manual, enable, etc.
      3) Operating status and fault data including ready, fail-to-run, etc.
      4) Timing/counting function data including preset and accumulated values.
   c. Operating, fault and diagnostic data derived from the external systems, such as chlorine generator, metering pump systems, including the following:
      1) Process variable transmitters and analyzers.
      2) Operating status of all system equipment including run and ready status.
      3) Power parameters.
      4) System trouble and alarm conditions.
      5) Process control system diagnostic data.
      6) System status, control and configuration parameters including lead/lag selection, operating set points, etc.
      7) Refer to the particular equipment specification section for specific data to be produced, consumed and transmitted by external systems.
   d. Operating data derived from electronic power metering systems including the following power parameters:
      1) Kilowatts
      2) Kilowatt-hours

3) Kilowatt demand
4) Kilovars
5) Kilovolt-amperes
6) Kilovolt-ampere-hours
7) Kilovolt-ampere demand
8) Power factor
9) Line currents
10) Voltage (phase-to-phase and phase-to-ground)
11) Line frequency.

e. Operating, fault and diagnostic data derived from solid-state adjustable frequency motor speed controllers including the following:
1) Run status
2) Drive fault
3) Start/stop control
4) Speed set point
5) Running speed
6) Running amps

f. Diagnostic data derived from the process control system controllers, I/O subsystems, and communications controllers including the following:
1) Controller operating mode
2) Controller performance (e.g. Scan time)
3) Controller fault status and fault code
4) Controller time and date values
5) Controller network address
6) I/O subsystem fault status
7) I/O module channel health
8) Communication controller fault status

g. Analytical, operating and diagnostic data derived from turbidity instruments including, but not limited to the following:
1) Instrument operating mode
2) Particle count in each of the particle size ranges configured.
3) Instrument diagnostic or fault status and status code
4) Instrument network address
5) Communication link status or fault condition.

h. Table 3.2.C.2.h specifies the types of derived process variables and the associated real-time process variable.

Table 3.2.C.2.h

Real-time Process Variable Type	Derived Process Variable	Description
Flow	Totalized Flow	Totalized flow process variable shall be defined for all flow process variables.
Level	Volume	A process variable representing tank volume shall be defined for all chemical and fuel storage tanks and shall be based on the real-time level process variable and the geometry of the storage tank.
Run Status	Accumulated Runtime	An accumulated runtime process variable shall be defined for all rotating equipment which has an associated run status tag defined in the tag database.

D. Data Logging

1. Tags representing the following types of process variables shall be defined in the tag database for data logging. This data shall support historical and real-time dynamic trending functions.
   a. Flow or chemical feed rate
   b. Process pressure
   c. Storage tank level or volume
   d. All analytical instrument values including pH, turbidity, particle count, temperature, and chemical residual
   e. Filter loss of head
   f. Chemical storage weight
   g. Power parameters representing line current, kilowatts, kilovars, kilovolt-amperes, and power factor.

E. Alarm Handling, Annunciation, and Logging:

1. Define all discrete tags representing alarm or trouble conditions in the tag database to be processed as alarms. All analog tags shall have alarm thresholds defined in the tag database. The value of the alarm thresholds shall be defined by the Owner during the preparation of the Process Control System Implementation Plan.

2. Configure the tag database to implement alarm processing and annunciation as defined by the Process Control System Implementation Plan. Each tag's alarm definition shall prescribe whether the occurrence of the alarm condition is logged to journal, printed, or audibly annunciated or any combination thereof.

3.3 GRAPHICAL OPERATOR INTERFACE DEVELOPMENT

A. General

1. The process control system graphical operator interface development shall include the preparation of the specified graphic displays in accordance with the Process Control System Implementation Plan and the requirements of this specification. The Systems Integrator shall prepare additional graphic displays as may be required to provide a comprehensive process and system management graphical operator interface.

B. Development Guidelines

1. The graphical operator interface shall be developed in accordance with recognized usability practices to insure efficient and effective use of the process control system. The completed graphical operator interface shall adhere to the following three principles of usability:
   a. Learnability: The graphical operator interface shall be easy to learn so that the user can quickly start being productive with the tools provided by the system.
   b. Efficiency: The graphical operator interface shall be efficient to use, so that once the user has learned the system, a high level of productivity is possible.
   c. Memorability: The graphical operator interface shall be easy to remember, so that the casual user is able to return to the system after some period of absence without the need to learn the interface over again.
2. Adherence to the stated principles of usability shall be achieved through consistent application of the following development standards defined herein and as defined in the Process Control System Implementation Plan.
   a. Graphic Design: The layout and organization of each graphic display shall be consistent among the graphic display types and shall adhere to the following standards:
      1) Position similar information and features of the graphical operator interface at the same location on each display.
      2) Enclose groupings of associated data in a frame or box.
      3) Color conventions shall be consistently applied throughout the graphical interface. Foreground colors shall be selected to provide contrast to the background color. Verify that all colors chosen can be viewed by the end-user.
      4) Text font sizes, colors and types shall be consistently applied throughout the graphical interface.

C. General Graphic Display Configuration

1. Graphic displays shall be configured as either full screen displays or pop-up displays. Each type of display configuration shall include the following features:
    a. Full Screen Display
        1) Full screen displays shall be maximized, occupying the full, usable area of the window.
        2) Controls to close or minimize the window shall be disabled.
        3) Window exit control shall be embedded in the graphic display's navigational controls.
        4) Full screen displays shall remain in the background when a pop-up display is called from navigational hot links within the full screen display.
        5) Navigational and utility button bars shall be provided.
    b. Pop-up Display
        1) Pop-up displays shall not occupy the full window and shall appear in the foreground when called from a full screen display.
        2) Pop-up displays shall appear at a user-defined location on the background display when called, but shall have the capability to be dragged to a different location on the screen.
        3) Pop-up displays shall not be resizable.
        4) Pop-up displays shall be provided with close control.

D. Graphic Display Types
1. Graphic displays shall be categorized as schematic overview, control panel, faceplate, trend, or utility.
    a. Schematic Overview: The schematic overview graphic display shall be presented as a process flow diagram and shall represent major process piping, major equipment, process variable data, and process alarm and status data.
        1) Schematic overview displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
            a) Numeric display objects shall be provided to indicate the instantaneous value of all analog process data associated with the process. In addition, dynamic fill shall be used to indicate analog process data representing level.
            b) Dynamic equipment symbols shall be provided to indicate run, off, and fault conditions for all major equipment associated with the process.
            c) An alarm summary object indicating only those alarms related to the associated process shall be provided at the bottom of the display.

d) Continuation labels shall be provided to access associated schematic overview displays.

e) Hot links shall be provided on equipment symbols to provide access to an associated control panel display or faceplate.

f) Hot links shall be provided on numeric display objects to access associated trend displays.

g) Navigational and utility button bars shall be provided.

h) Schematic overview shall be a full screen display.

b. Control Panel: The control panel graphic display shall be presented as a virtual control panel providing a point of operator interface for control of a specific equipment item or system.

1) Control panel graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:

a) Graphical control objects representing selector switches, pushbutton, slider bars, etc., shall be provided to initiate the appropriate control function.

b) All pertinent operating status data associated with the equipment or system controlled by the panel shall be indicated.

c) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.

d) Control panels shall be configured as pop-up graphic displays.

c. PID controller Faceplate (if used): The PID controller faceplate graphic display shall represent the appearance and functionality of a typical PID controller. The PID controller faceplate graphic display shall provide a point of operator interface for control of a specific process.

1) PID controller faceplate graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:

a) Analog data shall be presented in numerical and bar graph format.

b) PID operating status such as mode, high/low limiting, deadband in effect, etc., shall be indicated.

c) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.

d) PID controller faceplates shall be configured as pop-up graphic displays.

d. Trend Display: The trend graphic display shall present a graphical trend object with the associated controls to adjust the time scale and scroll the time axis.

1) Trend graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
    a) A pen legend shall be provided which associates the trend plot to a process variable description through the use of color.
    b) Y-axis shall be graduated and labeled in the appropriate engineering units.
    c) Controls shall be provided to adjust the time scale and to scroll the X-axis backwards and forwards.
    d) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
    e) Trend graphic displays shall be configured as pop-up graphic displays.

e. Utility Display: The utility graphic display shall present all pertinent data associated with an ancillary support system. The utility graphic display shall provide a point of operator interface for control, monitoring and management of the specified utility system.
    1) Utility graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:
        a) Provide a schematic representation of the utility system where specified.
        b) Numeric display objects shall be provided to indicate the instantaneous value of all analog process data associated with the utility.
        c) Dynamic symbols or labels shall be provided to indicate current condition of the utility and its components.
        d) Graphical control objects representing selector switches, pushbutton, slider bars, etc., shall be provided to initiate the appropriate control function.
        e) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.
        f) Control panels shall be configured as either full screen displays or pop-up graphic displays, as specified.

f. PLC System Status Display: The PLC system status graphic display shall present all pertinent data associated with the process PLC system itself. The PLC system status graphic display shall provide a diagnostic interface for troubleshooting, monitoring and management of the PLC system. No control is associated with the PLC system status graphic displays.

1) PLC system status graphic displays shall be prepared in accordance with the following guidelines except as otherwise modified by the Process Control System Implementation Plan:

   a) Provide a schematic representation of the PLC system where specified.

   b) Provide detailed displays for each PLC processor showing the processor status, including diagnostic and fault codes. Display shall include communication status of Ethernet, IObus and any additional communication links associated with the processor.

   c) Status of all discrete I/O points shall be indicated by dynamic text or colored graphical object. Status and raw data value of all analog I/O points shall be indicated by dynamic text.

   d) Dynamic symbols or labels shall be provided to indicate current condition of the processor and its components.

   e) Navigational control in the form of short-cut icons or labels shall be provided to access associated graphic displays.

E. Navigation System

1. The navigation system shall be configured to provide a logical, intuitive path through the graphical operator interface and also provide the flexibility to directly access graphic displays and system utilities. The graphical operator interface shall be generally organized by process area; however, shortcuts shall be provided to navigate beyond process boundaries.

2. The graphical operator interface shall incorporate features to accommodate mouse-oriented navigation throughout the process control system. Scrollable menus, button bars, embedded hotlinks and continuation labels shall be used to create a navigational system which provides ready-access to commonly used displays and utilities.

3. The navigation system shall be implemented in accordance with the following guidelines unless otherwise modified by the Process Control System Implementation Plan:

   a. Process Overview Graphic Display: A process overview display schematically representing the overall facility shall be function as the system startup display and "home base" for conventional system navigation. Embedded hot links shall be provided on this display to permit access to all other displays.

   b. Continuation Labels: Continuation labels shall be provided on all process schematic displays where a process line continues to another process area. These labels shall have embedded hot links to the process schematic display referenced by the label.

c. Graphic Menu System: A graphic menu system shall be provided where the navigational control action can result in multiple options. A graphic menu display shall be configured as a pop-up display and shall provide short cuts to associated graphic displays.

d. Short Cut Icons: Short cut icons shall be utilized to provide direct access to typical display types. Short cut icons shall be provided to represent schematic displays, control panels, trend displays, and PID controller faceplates. Short cut icons shall typically be applied to pop-up displays such as graphic menus, control panels, faceplates, and trend displays.

e. Hot Links: Hot links shall be embedded in each of the following types of display objects to provide access to an associated display or menu:

Table 3.3.E.3.e

Display Object	Hot Link
Equipment Symbol	Associated trend, PID controller faceplate, control panel or graphic menu display
Numeric Display	Associated trend display

3.4 PROCESS CONTROL LOGIC DEVELOPMENT

A. The process control system control logic development shall include the preparation of control logic required to implement the specified control strategies and support the specified operator interface functions.

B. Organization

1. Organize the control logic in a hierarchical structure which correlates to the actual process relationships. Prepare individual control logic program files for each system or equipment item and organize by process area. Similarly organize data table files by process area. Data types shall be consistently applied throughout the control logic in accordance with the Process Control System Implementation Plan.

2. The control logic and data table organization shall facilitate the addition of future control logic.

C. Documentation

1. Completely annotated all control logic down to and including the instruction level. Provide each rung or statement of control logic with annotation specific to its function. Provide a title and detailed description of the control strategy represented by the control logic for each program file. Apply terminology consistent with the Process Control System Implementation Plan throughout.

D. Control Logic Implementation:

1. The project control strategies outline the general control requirements of the treatment process and associated utility systems. In addition to the requirements of the control strategies, the following control features shall be implemented in the process control logic:

a. Fail to operate: Monitor all automatically operated equipment for failure to respond to control requests from the process control system. Initiate a fail timer upon a call to start, stop, open, close, etc. If the appropriate equipment status signal (run, off, full open, full closed) is not reported back to the process control system within the time duration defined by the fail timer, initiate an alarm through the process control system MMI.

b. Time based control: Process control logic for all equipment and processes controlled on the basis of time duration shall provide for operator access to the preset value of the time function through the MMI and report back to the MMI the instantaneous value of the time function associated value.

c. PID Regulatory control: Interface every PID regulatory control function implemented in the process control logic with the MMI to provide the following functions:

    1) Report to the MMI the instantaneous values of the process variable, set point, and control variable.

    2) Report to the MMI the current operating mode, high/low limiting in effect, deadband in effect, cascade mode in effect, etc.

    3) Provide operator control of the operating mode, set point value, and the control variable in manual mode.

    4) PID tuning parameters shall be accessible via password protected screens. Supervisor level access is required for modification of tuning parameters.

d. Control Setup Control functions which are described in the control strategies as operator initiated or invoked through the process control system MMI shall be interfaced with the MMI to permit operator manipulation of that control function and to report back the current status of the control configuration. Functions of this type include manual start/stop, lead/lag selection, hand/off/automatic selection, enable, set point adjustment, etc.

e. Real Time Data Server Communication: Control logic shall be implemented to facilitate and optimize the communication of data between the process control system real-time data server and the process controllers. Paragraph 3.2 of this specification defines the types of tags to be defined in the tag database. Control logic shall be implemented as required to make the specified real-time data available to the tag database. Control logic shall also be provided to support optimization of the communication between the process control system MMI real-time data server and the process controllers. Data of similar format (binary, integer, floating point, string, etc.) shall be grouped in data tables designated a communication buffer files. All tags defined in the tag database shall be addressed to the designated communication buffer files.

3.5 ON-LINE HELP

A. Develop an on-line help system to provide an on-line reference for the use of the process control interfaces and a description of the conventions used throughout the graphical operator interface. The on-line help utility shall be WinHelp or HTML-based and shall address the following topics:

1. Graphical conventions used in the operator interface including symbols, icons, colors, etc.
2. Graphical operator interface navigation system.
3. Standard procedures for login/logoff, printing, etc.
4. Functional description of each control panel graphic display including a graphic image of the display and descriptions of each object on the display.

B. Topics in the help system shall be dynamically-linked with other related topics through the use of hypertext-sensitive jumps and popups. All help pages shall be indexed with keywords to facilitate the use of the help utility. The on-line help utility shall include a table of contents, index and glossary.

C. The on-line help system shall be called from the utility button bar within the graphical operator interface.

3.6 HISTORICAL DATA MANAGEMENT SYSTEM

A. The historical data management system development shall include the preparation of extracts to enter the following real-time process variable types and associated attributes into the historical database.

Table 3.6

Process Variable Type	Sample Interval	Attribute			
		Total	Average	Maximum	Minimum
Flow	Hourly		X	X	X
	Daily	X			
Level	Daily		X	X	X
Power	Daily	X	X	X	X
Pressure	Daily		X	X	X
Equipment Run	Daily	X			
Water Quality Analysis	Hourly		X	X	X
	Daily				
Volume/Weight	Daily		X	X	X

3.7 TESTING AND COMMISSIONING

A. Test and commission the graphical operator interface in accordance with specification 40 98 00.

END OF SECTION 40 96 35

SECTION 40 98 00

PROCESS INSTRUMENTATION AND CONTROL TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	References
1.3	Submittals
2.1	Project Labeling
3.1	General
3.2	Factory Test
3.3	Pre-Operational Performance Testing
3.4	Functional Testing
3.5	Operational testing

B. Description

1. This section specifies Contractor and Systems Integrator performance in testing and documentation of process instrumentation and control system materials and equipment (PICS).
2. The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.
3. Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all testing with Section 01 91 13.

1.2 REFERENCES

A. Reference Standards

1. This section contains references to the following documents with additional references listed in Section 40 90 01.
2. All references shall be to the current edition of the document unless specifically stated otherwise. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

3. 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, reference 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.
4. Where document dates are given in the following listing, reference 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
ISA RP7.1	Pneumatic Control Circuit Pressure Test
ISA S51.1	Process Instrumentation Terminology

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Definition Submittals

a. Provide the following submittal after review of the Qualification Submittal:

1) Control descriptions.

2) I/O Interface Summaries.

3) Testing status spreadsheets per paragraph.

4) Test procedures per paragraph 3.1.D.

5) Proposed test forms per PART 3 of this Section 40 98 00, detailed for each test for this project.

6) Certified Factory Calibration Reports.

7) Provide a copy of this specification and the referenced and applicable sections with addenda updates included with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

8) Provide a copy of Section 40 96 20 – Instrument Index with addenda updates included, marked to indicate requested deviations from specified requirements.

9) Provide a copy of all referenced and applicable Instrumentation Drawings with addenda updates included, marked to indicate requested deviations from specified requirements.

10) Provide a copy of all referenced and applicable Electrical Drawing's Control Diagrams with addenda updates included, marked to indicate requested deviations from specified requirements.

11) Failure to include a copy of the specifications and drawings with the submittal shall be cause for rejection of the entire submittal with no further consideration.

2. Product Data
   a. Provide the following product data submittal after completion of testing.
      1) The following information shall be provided in accordance with specification Section 01 33 23:
         a) Completed test forms per PART 3.
         b) List of factory calibrated items and calibration certificates.
         c) Documentation of network data communication nodes for network type instruments, devices, and variable frequency drives.
3. Schedule Submittals
   a. FAT schedule and location.
4. Qualification Submittals
   a. Provide the following submittal in accordance with Section 01 33 23 – Shop Drawings, Product Data, and Samples:
      1) Example test forms per paragraph 3.1 D, revised to show Project Labeling per paragraph 2.1.A.
      2) Example I/O interface summary.

PART 2 PRODUCTS

2.1 PROJECT LABELING

A. The items specifying project labeling herein shall include the following as a minimum: Owner's name, facility name, project name, and project number.

PART 3 EXECUTION

3.1 GENERAL

A. General Requirements

1. Inspect materials, equipment, and construction included under this specification in accordance with this section and subsequent sections of this division. Perform testing in accordance with this and subsequent sections of this division.
2. No required test shall be applied without prior notice to the Engineer. Between 60 and 70 days before the commencement of any testing activity, provide a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.
3. Provide detail assistance to the Contractor in generating form the Equipment Test Report Form (Section 01 91 13), customized for this project. Submit detailed form prior to testing per the requirements of Section 01 91 13

B. Technician Qualifications

1. Field instruments and analyzers shall be calibrated and set up by a certified instrument technician qualified to calibrate the instrumentation.
2. Technicians shall be qualified by completion and certification from training courses offered by The Instrumentation, Systems, and Automation Society (ISA), the instrumentation and analyzer manufacturer's training courses, or technician training courses at a recognized trade school that specializes in instrumentation calibration.

C. Test Equipment and Materials

1. Provide test equipment to conduct the specified tests that simulate inputs and read outputs with a rated accuracy at the point of measurement at least three times greater than the component under test.
2. Test instruments shall have a current calibration sticker showing date of calibration, deviation from standard, name of calibration laboratory and technician, and date recalibration is required. Include certified calibration reports traceable to the National Institute of Standards and Technology with the final test report.
3. Provide a documenting calibration system to conduct process instrumentation calibration activities that consist of a documenting process calibrator and an instrumentation data management software system that captures the calibration results and electronically document instrument data, date of calibration, calibration procedures, and as-found and as-left instrument calibration data.
4. Provide buffer solutions and reference fluids for tests of analytical equipment.

D. Field Test Procedure Documentation

1. Submit test procedures for approval within 90 days from the date of Notice to Proceed.
2. Organized and assembled test procedures for each analog and discrete loop in the process control system in separate volumes for each process area. Submit final test records in electronic form by scanning and converting the records and files to Adobe PDF format, to preserve actual signatures and signoffs.
3. Include a detailed, step-by-step description of the required test procedure, panel and terminal block numbers for points of measurement, input test values, expected resultant values, test equipment required, process setup requirements, and safety precautions in the test procedure documentation.
4. Include test report forms for each loop, including forms for wiring, piping, and individual component tests, with the test procedure documentation. Record the actual test results on these forms and a final test report assembled as specified in paragraph 3.5.
5. Preprint and complete test report forms to the extent possible prior to commencing testing. Include the following information on test report forms that document the field test procedures:

a. Project name
b. Process area associated with the equipment under test.
c. Instrument loop description.
d. Instrument loop identification number.
e. Instrument nameplate data.
f. Instrument setup and configuration parameters.
g. Time and date of test.
h. Inspection checklist and results.
i. Reference to applicable test procedure.
j. Expected and actual test results for each test point in the loop including programmable controller data table or register values.
k. Test equipment used.
l. Space for remarks regarding test procedure or results, unusual or noteworthy observations, etc.
m. Name, date, and signature of testing personnel.
n. Test witness' name and signature.

E. Performance Deviation Tolerances

1. Tolerances shall be specified in Division 40. Where tolerances are not specified, refer to the manufacturer's published performance specifications.
2. Overall accuracy requirements for loops consisting of two or more components shall be the root-summation-square (RSS) of the component accuracy specifications. Calculate and record tolerances for each required calibration point on the associated test report form.

F. Installed Tests

1. Equipment and System Performance and Operational Testing - Section 01 91 13 specifies testing of the mechanical, electrical, instrumentation and HVAC systems. The Contractor's Quality Assurance Manager shall coordinate, manage, and supervise the quality assurance program that includes:
   a. Testing plan with the sequence for the test work.
   b. Calibration program for all instruments and analyzers.
   c. Documentation program that records tests results.
   d. Performance testing program systems.
2. Test forms provided shall conform to the requirements of reference forms 40 90 01-A through 40 90 01-K included in Section 40 90 01. Additional or detailed forms shall be developed as necessary to suit complex instrumentation. Usage of terms used on test forms shall comply with ISA S51.1.

G. Witnessing

1. The Engineer reserves the right to observe factory and field instrumentation testing and calibration procedures. Notify the Engineer prior to testing, as specified herein.

3.2 FACTORY TEST

A. Factory Acceptance Test (FAT)

1. General:

a. Subject control system equipment to a FAT with the factory acceptance tests and subsequent retests witnessed by the Engineer and Owner. Load control system panel programmable logic controllers with the PLC software, Operator Interface software and the programming and graphic configuration application software at the control system equipment supplier's factory prior to the FAT.

b. Equipment, panel instruments, panels, or cabinets shall be inspected with factory testing performed. Provide written notice to the Engineer thirty working days before the commencement of the FAT activity and include:

1) Schedule for the FAT.

2) Location of the FAT.

3) Testing equipment used.

4) Detailed test procedure with forms for the recording of test results.

5) Sign-off spaces for the individuals performing and witnessing the tests.

2. Factory Acceptance Test Procedures:

a. Panels provided shall be interlocked or networked as applicable, operated, and checked-out by the equipment supplier prior to the FAT. Submit certification indicating that the panels are ready for the FAT.

b. The FAT shall include the following:

1) Visual inspection of equipment, instruments, control panels, and graphic displays.

2) Validation of each input loop and output loop by simulated signals for analog inputs and by shorting discrete inputs.

3) Validation shall include:

a) Monitoring state changes on operator interface screens based on the inputs state change.

b) Observation of online PLC programming application software with the associated PLC outputs state change.

c) Outputs triggered by operator interface software devices (pushbuttons, sliders, manually-entered values, etc.)

d) Calibration and operation of instruments on or in the control panels.

4) Repair of loops which do not pass validation.

5) Retest of the FAT at no additional cost.

c. Panels that pass the FAT may be shipped to the site upon shipping schedule and storage accommodation approval by the Construction Manager.

3.3 PRE-OPERATIONAL PERFORMANCE TESTING

A. General Requirements:

1. In general, tests shall be performed in the following order:

B. Wiring Tests:

1. Conduct electrical power and signal cable ring-out and resistance testing in accordance with Sections 26 00 01. Do not conduct wiring tests until cables have been properly terminated, tagged and inspected.

a. Power and Control: Per Section 26 00 01.

b. Signal: Test form 40 90 01-A.

C. Piping Tests:

1. Pneumatic Piping Systems: Pneumatic piping systems shall be tested for leaks in compliance with ISA RP7.1, except performed at ten times the normal system operating pressure. Test form 40 90 01-B.

2. Liquid Piping Systems: Tested for leaks in compliance with Section 01 45 23.13.

D. Instrumentation Calibration:

1. Field calibrate instruments and final elements in accordance with the manufacturer's recommended procedures and tested in accordance with the Contractor's test procedure.

2. Do not commence Individual Component Calibration and Testing until Instruments and Component Inspections are completed and documented to the satisfaction of the Engineer.

3. Analog instrument calibrated at 0, 10, 50, 90, and 100 percent of the specified full scale range. Adjust each signal sensing trip and process sensing switch to the required setting. Test data recorded on test forms as specified herein.

4. Tested and adjusted final element alignment to verify that each final element operates smoothly over the full range in response to the specified process control signals.

5. Enter test data on the applicable test forms at the time of testing: Set alarm trips, control trips, and switches to initial values specified in Section 40 96 20 – Instrument Index at this time. Check final elements for range, dead-band, and speed of response.

6. Have the manufacturer repair or replace any component that fails to meet the required tolerances. Repeat the specified tests until the component is within tolerance.

7. Install a calibration sticker on each instrument following successful calibration that indicates the date of calibration, the name of the testing company, and personnel who calibrated the instrument.
8. Test forms 40 90 01-C through 40 90 01-I.
9. Certified Test Reports: Field test and inspection activities include verification of instrument parameter setup, verification of instrument zero, and performance at three operating points within the instrument range. Return instruments which fail to demonstrate proper performance for re-calibration or replace as agreed depending on the impact to the project as determined by the Engineer.
10. Where instrument field calibration is not feasible, certified factory calibration reports may be submitted that includes the name and address of the laboratory that conducts the calibration testing. Certified factory test reports may be submitted for the following instrument types in lieu of field calibration:

Instrument Identification	Instrument Section	Title
FM	40 95 51	Magnetic flow metering system
FM-C	40 95 51	Magnetic flow metering system - compact
FTD	40 95 51	Thermal dispersion flow metering system
FTT-F	40 95 51	Transit time flow metering system, flanged
FVA	40 95 51	Variable area flow transmitter
TNE	40 43 13	Resistance temperature element, non-intrusive type
TRE	40 43 13	Resistance temperature element, insertion type

E. Loop Testing

1. Do not commence Loop Testing until the Individual Component Calibration and Testing has been completed and documented to the satisfaction of the Engineer.
2. Test each instrument loop as an integrated system. Check operation from field instruments to transmitter to receiving components to the vendor panel or the Plant Control System Operator Interface Station. Inject test signals at the process impulse line connection where the measuring technique permits, and otherwise at the most primary signal access point.
3. Testing of loops with an interface to a programmable logic controller shall include verification of the programmable logic controller input/output assignment and verification of operation of the input/output system and processor. Inspect the data table or register in the programmable logic controller memory to verify proper operation.
4. If the output control or monitoring device fails to indicate properly, make corrections to the loop circuitry or device. Repeat the test until devices and instruments operate as required.
5. Correct loop circuitry and repeat the test until the instruments operate properly.

6. Test form 40 90 01-J.

3.4 FUNCTIONAL TESTING

A. Process Control Strategy/Functional Testing:

1. Do not commence Control Strategy Testing until the Loop Testing has been completed and documented to the satisfaction of the Engineer.
2. Control Strategy Testing is performed by the Programmer and consists of installing and debugging the PLC control logic program, verifying the interface points between the PLCs and field devices and equipment, and exercising the control strategies. Control Strategy Testing will be performed on one PLC at a time.
3. Provide qualified personnel to immediately correct any deficiencies in the Work that may be encountered during Control Strategy Testing. Failure of the Contractor to provide such personnel in a timely manner may prolong the time allotted to complete Control Strategy Testing.

B. Control System Closed Loop Testing:

1. Do not commence Closed-Loop Commissioning until the Control Strategy Testing has been successfully completed and documented to the satisfaction of the Engineer
2. Closed-loop commissioning tests, performed as part of the system tests, shall demonstrate stable operation of each loop under operating conditions. Tests shall include adjustment of loop tuning parameters.
3. Tuning parameters: gain (or proportional band), integral time constant, and derivative time constant for each control loop, adjusted to provide 1/4-amplitude damping, unless otherwise specified.
4. Provide the loop response to a step disturbance for each loop. Make two graphs for cascaded control loops, one showing the secondary loop response with its set point in manual, and the second showing overall loop response.
5. Adjust control loops with "batch" features to provide optimum response following start-up from an integral action saturation condition.
6. Provide graph recording showing the response and make at sufficient speed and amplitude to show 1/4 amplitude damping. Label to show loop number and title, and settings of parameters and set point.
7. Where a loop is controlled under the direction of a programmable logic controller, the Engineer will perform the necessary adjustment of loop tuning parameters and set points; Contractor shall record the loop response, adjusting final elements, and assuring total integrated loop performance as specified.

C. FUNCTIONAL CHECKOUT:

1. Conducted to verify the operation of discrete and hardwired control devices, refer to Section 01 91 13. Exercise the operable devices and energizing the

control circuit. Operate control element, alarm device, and interlocks to verify the specified action occurs.

3.5 OPERATIONAL TESTING

A. Perform System Acceptance Test (SAT) after component and subsystem tests have been completed. Perform the test of the completed system in full operation and demonstrate that all functional requirements of this specification have been met. Demonstrate the following:

1. Each component of the system operates correctly with all other components of the system.
2. Analog control loops operate in a stable manner.
3. Hard-wired and software equipment interlocks perform correctly.
4. Process control sequences perform correctly.
5. PLC application program performs monitoring and control functions correctly.
6. Operator interface graphics represent the monitoring and control functions correctly.

END OF SECTION 40 98 00

SECTION 03 10 00

CRANES AND HOISTS

PART 1 - GENERAL

1.1 SUMMARY

A. Scope

1. Furnish, install and make fully operational the crane and hoist systems in the locations and conditions of service, as shown on the Drawings and as specified in this Section.

B. Related Requirements

1. See Section 051200 "Structural Steel" for crane runway girder and support framing.
2. Consider these Specifications as minimum requirements. Add such additional features as are necessary for satisfactory operation.
3. Supply all equipment under this Specification in compliance with the provisions of OSHA, as well as all applicable industrial codes in the State in which the project is located.
4. The manufacturer and ultimately the Contractor are solely and totally responsible for structural design of the crane and hoist systems, for the compatibility of all equipment, and for verification of required operating clearances.
5. Design and construct all parts of the mechanism furnished for the maximum stresses occurring during fabrication, erection and continuous operation. Design all equipment specified herein for the Crane Manufacturer's Association of America Duty Classification as specified herein.
6. If the Contractor elects to utilize the crane and hoist equipment in any way during the erection of piping and installation of equipment, notify the Owner in writing and provide for an inspection by the equipment manufacturer and take any steps necessary to return the equipment to "as new" condition. Also obtain recertification by the manufacturer and reinstate all warranties and guarantees.

1.2 REFERENCES

A. Reference Standards

1.	CMAA	Crane Manufacturers Association of America
2.	AISC	“Manual of Steel Construction”
3.	ASTM A48	Standard Specifications for Gray Iron Castings
4.	ANSI B30.16	Safety Code for Overhead Hoists
5.	OSHA 1910-179	Occupation Safety and Health Administration

1.3 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Product Data
   a. Manufacturer's literature including cut sheets and all necessary information to enable evaluation of product quality and performance for the following items as applicable.
      1) Bridge
      2) Runway Crane Rail and anchorage
      3) Drive motor
      4) Gears and bearings
      5) Trolley drive system
      6) Hoist motors and assemblies
      7) Brakes
      8) Hooks
      9) Starting systems and/or variable speed drive systems
      10) Electrical system including conductors and all components (bus bar, festoon, etc.)
      11) Remote and pendant control station assemblies
      12) Manufacturer's paint system for crane and hoist assemblies.

2. Shop Drawings
   a. Detailed fabrication drawings for items identified above.
   b. Detailed layout drawings showing the configuration and dimensions of the proposed assemblies including cranes, runway beams, and associated supports.
   c. Cross-section and elevation drawings of entire crane/hoist system.
   d. Wheel loading on runway beams.
   e. Detailed power and control wiring diagrams, including terminals and numbers.
   f. Complete control schematics including equipment, devices, variable speed drives, etc.
   g. Motor nameplate data.

3. Certificates
   a. Obtain and provide certification that the crane systems have been designed to resist all loads implied herein and loadings stipulated in the applicable building codes of the State of Georgia.
   b. Certification must also state that the crane system design has been performed under the supervision of, and be signed and sealed by, a Professional Engineer registered in the State of Georgia.
   c. Performance Affidavit.

4. Delegated Design Submittals
   a. Submit details and design calculations signed and sealed by a Professional Engineer currently registered in the State of Georgia for all components of the provided crane system.

5. Test and Evaluation Reports
   a. Provide written certification that the equipment has been field tested, and has passed.

6. Quality Control Submittals
   a. Manufacturer's Certification of Proper Installation.

7. Special Procedure Submittals

a. Welder and welding procedure certifications per AWS D1.1.
b. Product Warranty.

B. Closeout Submittals

1. Operation and Maintenance Data
   a. Operation and maintenance manuals.

2. Warranty Documentation
   a. Final certified warranty.

3. Record Documentation
   a. Redlined drawings of any modifications made during erection and installation of the systems.

C. Maintenance Material Submittals

1. Spare Parts
   a. Spare parts list to maintain equipment in service for a period of five (5) years.

2. Tools
   a. List of special tools, materials, and supplies furnished with equipment for use prior to and during start-up and for future maintenance.

1.4 QUALITY ASSURANCE

A. Qualifications

1. Manufacturers
   a. The equipment covered by these Specifications is intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Deliver and inspect the product in accordance with the requirements of Section 01 65 00.

B. Storage and Handling Requirements

1. Store and handle the product in accordance with the requirements of Section 01 66 00.

1.6 WARRANTY

A. Manufacturer Warranty

1. Provide Warranty and Guarantee as specified in Section 01 78 36 but for a warranty period of two (2) years.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers

1. Manufacturer List
   a. Bridge Cranes and Trolley Hoists:
      1) Konecranes
      2) DEMAG
      3) EMH, Inc.
      4) PWI
      5) HSI
      6) SPANCO, Inc.
      7) TC/American Inc.
      8) Trambeam division of ACCO Material Handling Solutions
      9) Yale
      10) Engineer approved equal

B. Description

1. Bridge Cranes
   a. Provide traveling bridge cranes with motorized bridges as indicated on the Drawings and as specified in this Section.
   b. Limit runway tolerances to those specified in Table 1.4.1-1 from the CMAA. Build cranes to operate on specified level runways held to nominal span within plus or minus 1/8-inch tolerance. Provide straight and level runways with a maximum of 1/2 degree horizontal variation and within span tolerance limits.
   c. Design cranes with a minimum safety factor of 5 to 1 in relation to the ultimate strength of the materials and a minimum resistance to permanent deformation of any of its parts of 3 to 1 in relation to the yield point of the materials, whichever of the two conditions will set the minimum.
   d. Crane runway girders and supports have been designed by the Structural Engineer of Record and are shown on the Drawings. Provide and install ASCE crane rail, track supports, clamps, stops, couplings, and other items required for a complete installation of the bridge crane system. Suitably support runways to withstand loading and impact shocks incurred under normal operation conditions.
   e. Size, provide, and install ASCE standard rails onto the runway girders per the CMAA specifications. Secure by hook bolts or other approved mechanical means to top member of each runway to provide a track for the end trucks of top running cranes.
   f. For bridge crane girder(s) provide an I-beam, wide flange, or box girder of proper size, designed to hold the rated load and in accordance with CMAA Specifications for standard structural shapes. For bridge beams, provide a selected structural member with level and straight tread surfaces for the trolley hoist.
   g. Brace and weld the bridge beam to maintain squareness with end trucks. Design end trucks for top running cranes to run on the top of the ASCE standard runway rails.
   h. Design the end trucks so that in the event of a wheel axle or wheel failure the drop of the load would be limited to 1 inch. Equip end trucks with sweeps which extend

below the top of runway rails and project in front of the crane wheels. Provide top-running crane wheels with double flange alloy steel and tread surfaces hardened to minimum 375 Brinell.

i. Design Class C end truck with a fixed axle, pin and taper design with double-row ball bearings and flat or tapered wheel treads.

j. Provide one (1) wheel in each end truck with a helical gear motor reducer for connection to the dual motor drive. Paint rated capacity of bridge crane with stencil on the hoist, crane girders, and runway beam.

k. Provide crane drive of the dual drive type incorporating two (2) squirrel cage motors with variable frequency control with 2-step in. Provide the dual drive motors with synchronous drive to both end trucks for all possible trolley, hoist, and load positions. Provide the motor gear heads fully enclosed and oil lubricated.

l. Support the motor and gear reduction shafts by permanently lubricated ball or roller bearings. Design all bearings in the crane wheels and gear reduction shafts for a B-10 life of 5,000 hours, minimum. With each crane drive include an integrally mounted electrically released disk brake.

2. Trolley Hoists

a. All load carrying parts must be steel. For the wheels provide hardened treads. Equip wheels and axles with antifriction bearings which are permanently sealed and lubricated.

b. For the gear head of the motor provide an alloy steel, heat treated gear train operating in a fully enclosed oil bath. For the gear shaft provide precision, oil lubricated ball bearings.

c. For electrically operated trolleys include variable frequency control with 2-step in., a gear-motor with solid-state soft start with adjustable time and torque, and electric brake.

d. Provide the hoist drive of the standard headroom, single reeved type, and including a geared train with inherent or mechanical load brake, hook, wire rope, and drum.

e. Stamp the rated capacity on the hoist frame. Design the frame to be oil tight, of cast steel construction, with no part of the load carried by assembly bolts.

f. Provide gearing that is machine cut and heat treated, and which operates in an oil bath. Except for the drum pinion, do not provide gears that are cantilever mounted. Ground and polish shafting and provide only antifriction type bearings. Provide ready access to grease fittings and oil reservoir.

g. Provide drum that is large diameter, guarded, flanged type with machine cut grooves to accommodate the hoist cable without overwrapping. Utilize right- and left-hand drum grooving in close-headroom, double-reeved, cross-mounted hoist applications to provide a true vertical lift.

h. Provide wire ropes of the preformed extra flexible type with a safety factor of at least five (5.0), and anchored to the hoist drum.

i. Provide load block of the safety type with guarded sheaves and forged swiveled hooks. Design hooks to open slowly when subjected to heavy overloads.

1) With electrically driven hoists include variable frequency control with 2-step in., direct coupled motor, electrical controls, and solenoid brake. Spring set the solenoid brake with magnetic release operated by and interlocked with the electrical control equipment. Provide either a worm gear drive with an inherent load brake or a mechanical load brake designed in accordance with the Hoist Manufacturer's Institute standards for controlling the speed when lowering, and for holding maximum hook load for any load up to capacity.

2) Provide stressed parts of cast or forged steel. In the event of a power failure design the braking system to automatically lock the piece of equipment being lifted to prevent further movement. With hoists include either a clutch-type or electric-type overload cut-off device to protect hoist from an overload condition.

j. Paint rated capacity of trolley hoists with stencil on the trolley hoist.

C. Performance/Design Criteria

1. Design the crane to withstand the dead load (caused by the weight of the crane and components themselves), the live load and hoist load, and the inertia forces caused by movement of the crane, components, and loads during standard operation.
2. Provide standard capacity ratings which represent the net rated load at the hook of any type of trolley hoist with the same load rating installed on the crane having a trolley hoist weight within the established limits.
3. Use only design loads which meet CMAA requirements. At a minimum, base the design load for stress calculations upon the capacity plus 15% for the weight of the hoist and trolley and an additional 25% for impact (capacity x 1.4). Base the design load for deflection calculations upon the capacity plus 15% for the weight of the trolley hoist (capacity x 1.15). Clearly label the rated load capacity on each crane using a label size easily read from the floor level and/or loading position.

D. Crane and Hoist Schedule

Criteria	**High Service Pump Station**
General	
Indoor / Outdoor	Indoor
Capacity, tons	See Drawings
Operating Floor Elevation	See Drawings
Crane	
Crane Type	Bridge
Mounting	See Drawings
CMAA Duty Classification	Class B (Light Service)
Span, ft	See Drawings
Max Bridge Speed, fpm	75 FPM, 2 STEP VFD
Trolley Hoist	
Trolley Type	See Drawings
Hoist Type	Electric Wire Rope
ASME Duty Classification	Class H3
Hook Elevation	-
High Point	See Drawings
Low Point	See Drawings
Hook End Approach, in	See Drawings

Operating Speeds	-
Trolley Speed, fpm	50/17 FPM, 2 STEP VFD
Hoist Speed(s), fpm	15/3 FPM, 2 STEP VFD

Note: Field verify all elevations and spans, values shown are approximate. Install all equipment as shown on the Drawings.

E. Operation

1. Electrical and Control Requirements
   a. Provide electrical power wiring and connection to the electrical system integral to the equipment under Division 26, Electrical.
   b. Rate all electrical appurtenances furnished by the equipment manufacturer for installation in classified areas where such areas are indicated on the Drawings or specified herein.
   c. Provide wiring between motor, limit switches and starters that is short, compact and protected by rigid galvanized steel conduit or flexible steel neoprene jacketed cable. In corrosive areas (i.e. Wet well), provide rigid galvanized steel conduit that is PVC coated.
   d. For the Electrical System providing power to the bridge crane drives, trolley drives, and hoists, supply either the insulated channel conductor type or the festoon type as specified herein.
      1) Insulated Channel Conductor Type: Supply an insulated channel conductor along the bridge crane rails and girder or monorail where specified herein. Provide a conductor capable of carrying 100 amperes per pole, 3 phase, and 460V. Support the conductor as recommended by the manufacturer. Provide conductor that is "Saf T Bar" enclosed electrification as manufactured by Howell Corporation, Midland Ross, SAFPOWER as manufactured by Cleveland Tramrail, Duct-O-Bar, Magnetek, Conductix, or equal. Provide conductor channels of stainless steel, flame retardant, amply double insulated. Design the system to permit longitudinal movement of the housing and busways only to the extent to allow for expansion and contraction. Provide an expansion joint section as required for expansion and contraction which can still maintain true alignment. Provide collectors of the type required by the conductor manufacturer.
   e. Design starting equipment to be integral with the crane drives and/or trolley hoist unit with three overload elements. House equipment in an enclosure suitable to the conditions of service and as specified herein.
   f. For hoisting motors provide two speed motors. For trolley motors provide a single speed squirrel cage induction motors NEMA Design "D". For motors provide the totally enclosed type designed for hoist service. Provide motor rating on a 30 minute 55°C, duty cycle basis.
   g. Electrical/Control Requirements:

	High Service Pump Station
Area Classification	Non-Classified
NEMA Rating of Components	NEMA 4X
Electrical System	
Control System	Pendent or Radio Control

Motors	
Rating	460V, 3-phase, 60 Hz
Bridge Motor HP	2 HP (each)
Trolley Motor HP	2 HP
Hoist Motor HP	20 HP
Enclosure	TEFC
Insulation	Class H
Inverter Duty	Yes
Service Factor	1.15
Space Heater	Yes
Motor Winding Temperature Switches	Yes

h. For limit switches provide approved geared typed, positive in action, compact, oil proof and readily accessible. For solenoid brakes provide disk type, spring set with magnetic release. Provide solenoids that are totally enclosed, protected from oil and moisture, readily accessible for adjustment and maintenance which develop the required forces without overheating.

i. Provide electrical and control components which conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards are not recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

2. Controls

a. For the Control System providing control of the bridge crane drives, trolley drives, and hoists utilize either wired pendent controls or wireless radio controls as specified herein.

b. Provide radio controls for lift and travel complete with transmitter, receiver, and mounting hardware, designed for both indoor and outdoor installations. Provide transmitter that is battery powered, consisting of a NEMA 4 gasketed, glass reinforced nylon enclosure with removable power key. Create two speed control of the hoist drive by two-step pushbuttons. Panel-mount a 110 VAC, 60 Hz receiver with NEMA 4 sealing. Furnish LED lights with the receiver for visual diagnostic feedback. For radio frequency provide microprocessor controlled with a range of no less than 300 feet. Acceptable manufacturers for radio controls are Enrange, Telecrane, or equal.

c. For control power, supply 120 volt provided by a control power transformer within the starter units. Ground one side of this transformer and connect the other side via a fuse of adequate rating.

F. Materials

1. Construct the crane system of structural steel, in accordance with current AISC (American Institute of Steel Construction) and ASTM (American Society for Testing and Materials) A36 specifications minimum.

G. Fabrication

1. Shop Fabrication

a. All crane components must have properly finished ends and surfaces.

2. Fabrication Tolerances
   a. For welding follow the current recommended practices of the AWS (American Welding Society) D14.1 specifications.

H. Finishes

1. Primer Materials
   a. One coat epoxy polyamide primer with 4 to 6 mils dry film thickness.

2. Finish Materials
   a. One coat of high solids epoxy polyamide with 4 to 6 mils dry film thickness.
   b. One coat of aliphatic polyurethane with 3 to 5 dry mils film thickness.

3. Shop Finishing Methods
   a. Perform a wire-brushing and/or solvent wipe prior to painting to clean and remove debris, mill scale, dirt, and oils.
   b. Paint the crane OSHA safety yellow before shipment.
   c. Paint rated capacity of crane system with stencil on all components of crane system as specified herein.

PART 3 - EXECUTION

3.1 ERECTION

A. Special Techniques

1. Install all crane equipment in accordance with the applicable sections of Division 05 - Metals, Division 26 – Electrical, and the manufacturer's instructions and recommendations.

B. Interference with Other Work

1. Separate moving members of the crane by a clearance of at least 3 inches vertically from any overhead obstruction, and 2 inches horizontally from any lateral obstruction.

3.2 REPAIR/RESTORATION

A. Ship at least one spray can of matching color paint, with each crane, for field touch-ups.

B. Properly band and skid the crane prior to shipment. Repair any paint damage, scratches, blemishes to the finish of the crane, caused by shipping, transportation via common carrier, etc.

3.3 FIELD QUALITY CONTROL

A. Field Tests and Inspections

1. Conduct field tests in accordance with the manufacturer's instructions and recommendations. Prior to initial use, proof-test all cranes at 125% of their rated load in accordance with all OSHA requirements.

2. Alignment: Test complete assemblies for proper alignment and connection, and quiet operation.

3. Performance Test
   a. Load test in compliance with OSHA, ANSI B30.11, and ANSI B30.16.
   b. Test by hoisting, lowering, and transporting loads rated at 0%, 60%, and 100% of nominal or rated load. Provide the required weights for testing.
   c. Test and demonstrate the performance of all safety devices.

B. Manufacturer Services

1. Provide the services of a qualified manufacturer's technical representative, including the following site visits for each crane and hoist system:

Service	**Number of Trips**	**Number of Days/Trip**
Installation and Testing	1	1
Startup and Training	1	1
Services after Startup	1	1

2. Prior to putting crane or hoist into operation, furnish a report certifying the runway, beams, and equipment has been properly installed, lubricated, aligned, and ready for operation.

END OF SECTION 41 22 00

SECTION 46 21 53

VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Administrative Requirements
1.3	Reference Codes and Standards
1.4	Submittals
1.5	Unit Responsibility
1.6	Delivery, Storage, and Handling
1.7	Field Conditions
1.8	Warranty
2.1	Equipment
2.2	Pump Construction
2.3	Suction Can
2.4	Spare Parts
2.5	Electrical and Control Requirements
2.6	Source Quality Control
3.1	Installation
3.2	Field Quality Control
3.3	Adjusting

B. Scope

1. This Specification is for Close-coupled water lubricated, vertical turbine pump installed in suction cans or wet well, as indicated on the Drawings, with above-ground flanged discharge and enclosed impellers. All parts of the pump exposed to water shall be of stainless steel, brass, heavy cast iron, or equivalent corrosion-proof material.
2. Furnish, install, provide start-up services, test, and place in satisfactory operation heavy-duty, electric, vertical turbine pumps for the locations identified in compliance with the Drawings and Specifications.
3. Unless otherwise specified herein, all applicable provisions of AWWA E-103 (Horizontal and Vertical Line Shaft Pumps), latest edition, are hereby made a part of these Specifications.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. The Contract Documents are intended to describe a pump installation for the specified purpose, complete and ready to be placed into service at the levels of performance indicated in the Drawings and outlined herein. By offering this service to the Owner, Contractor affirms that they are fully knowledgeable regarding the required methods and materials, and are capable of performing such installation. The omission of specific details and / or steps from the Drawings or Specifications, required to perform this installation shall not relieve the Contractor of their sole responsibility for this end result, nor shall such omissions be grounds for requests for additional compensation.
2. Coordinate with other manufacturers and suppliers to provide all details and appurtenances necessary to properly install, adjust, and place in satisfactory operation a complete working unit.

B. Definitions

1. The term “Pumping Unit” or “Units” shall be defined as a pump complete with motor, head assembly, bowl assembly, column assembly and other materials and components as described herein.

1.3 REFERENCE CODES AND STANDARDS

A. All equipment and materials shall meet the applicable provisions of the following reference codes and standards.

1. Hydraulic Institute (HI)
2. American Iron and Steel Institute (AISI)
3. American National Standards Institute (ANSI)
4. American Society of Testing and Materials (ASTM)
5. American Water Works Association (AWWA)
6. International Organization for Standardization (ISO)
7. Anti-friction Bearing Manufacturers Association (AFBMA)

1.4 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Shop Drawings
   a. Submit the following items with the Shop Drawings in accordance with, or in addition to, the requirements specified in Section 01 33 00 – Shop Drawings, Product Data, and Samples and Section 01 60 00 – General Equipment Stipulations:
      1) Certified pump curves based upon factory testing by the pump manufacturer for approval by the Owner, for each pumping unit to be furnished herein; showing:
         a) Indicate flow, head, efficiency, brake horsepower, NPSHr, and minimum submergence.
         b) Each curve shall be continuous over the full operating range from zero (0) flow up to the maximum flow permissible through each pump, and each curve shall be based upon the RPM listed herein.
         c) For variable speed operation, if applicable, include curve for operation at the specified minimum RPM.

d) Each curve shall state the RPM speed of the pumping unit, and shall be furnished full-size on 8 1/2" x 11" paper.

e) Include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.

f) Column and head losses, thrust data, etc.

g) Provide statement by Pump Manufacturer specifying the "Allowable Operating Range" as defined by the HI Standards and AWWA E-103 Standard.

2) Submit calculations and written certification from pump manufacturer that the pump furnished herein will operate compatible with the Net Positive Suction Head (NPSH) available.

3) General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.

4) Detailed fabrication drawings of said pumping unit material and dimensioned installation drawings.

5) Detailed description of construction, including a parts list with materials of construction and metallurgy with ASTM designations.

6) Submit details of fabricated steel discharge head and provide written certification from pump manufacturer that the discharge head has the capability of accommodating the specified drives and the design column length within acceptable vibration limits.

7) Submit seismic calculations signed and stamped by an engineer.

8) Provide coating manufacturer's information and data for fusion bonded epoxy lining and coating.

9) Functional description of internal and external instrumentation and controls, including a list of parameters monitored, controlled, or alarmed.

10) Motor performance chart showing curves for torque, current, power factor, input/output power, and efficiency and data on starting and no-load characteristics.

2. Field and Test Procedures

a. Submit shop testing procedures at least thirty (30) days prior to the test.

b. Submit detailed field procedure for installation, adjustment, inspection, and testing of all pumping equipment.

3. Manufacturer Reports

a. Submit a certified report prepared by the manufacturer's technical representative certifying satisfactory installation, operation, and in-service placement of pumps.

B. Closeout Submittals

1. Operation and Maintenance Data

a. Submit Operating and Maintenance Manuals in accordance with Section 01 78 23 – Operating and Maintenance Data.

2. Warranty Documentation

a. Include the manufacturer's warranty in the compiled warranty submittal of all manufacturers' warranties in accordance with Section 01 78 36 – Warranties and Bonds.

C. Maintenance Material Submittals

1. Spare Parts

a. Include manufacturer's information for the spare parts specified herein with the Shop Drawing submittal.

2. Tools

a. Include manufacturer's information for the special tools and supplies specified herein with the Shop Drawing submittal.

1.5 UNIT RESPONSIBILITY

A. General

1. The Pump Manufacturer shall be responsible for providing the pump, lineshaft, pump shaft, motor shaft (with bronze adjusting nut), column piping discharge head, and the motor as a complete unit to the Contractor for installation.

2. During the submittal process, the Pump Manufacturer shall provide a notarized certificate stating that all equipment and materials listed above will be provided by the Pump Manufacturer.

3. Pump Manufacturer or representative shall attend pump start-up and provide field services for assistance to the Contractor.

B. Compatible Equipment

1. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the Contractor and the listed manufacturer shall be responsible for the compatibility and successful operation of the various components of the units conforming to the specified requirements.

2. All necessary mounting, couplings and appurtenances shall be included with each unit.

3. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements

1. Ship components containing bearings with lubricant on all bearings.

2. Deliver all components to site in manufacturer's shipping crates or boxes.

3. Deliver to site undamaged.

B. Storage and Handling Requirements

1. Protect from corrosion and mechanical damage.

2. Protect electrical components from condensation.

3. Ship power and control cables with securely-attached caps on cable ends to prevent moisture wicking into cable during storage.
4. Store with lubricant on all bearings.
5. Handle all components in such a manner to prevent damage during unloading and installation.
6. Follow manufacturer's instructions regarding lifting and setting.

1.7 FIELD CONDITIONS

A. Ambient Conditions

1. Equipment Installation Location:
   a. High Service Pumps: Indoor installation with below grade cans for the suction well of the pump. The pump room is provided with exhaust fans, but no direct cooling provided.
   b. Transfer Pumps: Outdoor installation through the top of a prestressed concrete clearwell.
   c. Backwash Pumps: Outdoor installation through the top of a prestressed concrete clearwell.

1.8 WARRANTY

A. Manufacturer Warranty

1. Provide manufacturer warranty as specified in Section 01 78 33 – Warranties and Bonds with the exception that the warranty period is for two (2) years from the date of acceptance of the equipment.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Manufacturers

1. Manufacturer List
   a. Peerless
   b. Goulds
   c. Engineer approved equal
2. Substitution Limitations
   a. The naming of a manufacturer in this Section is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

B. Performance/Design Criteria

1. The pumps shall operate within the Hydraulic Institute standards and pump manufacturer's requirements under the design operating levels indicated on the Drawings. The Pump Schedule data below indicates the minimum hydraulic performance requirements for each pump (Design Condition #2).
2. Pump Schedule:

Pump Location	High Service Pump Station		
Number of Units	2		
Designation/Tag Numbers	HSP-101, HSP-105		
Discharge Head Size (inches)	20 x 20 x 24.5,150 lb. Flg.		
Minimum Column Diameter (inches)	20		
Minimum Line Shaft Diameter (inches)	2.6875		
Bowl Assembly Diameter (inches)	27 (Nominal)		
Suction Bell Diameter (inches)	27 O.D.		
Suction Can Diameter (inches)	36 O.D.		
Liquid Pumped	Potable Water		
Temperature of Liquid Pumped	Ambient		
Suction Condition	Flooded		
Drive Type	Variable Speed		
Minimum Stable Continuous Flow (gallons/minute)	5,479		
Design Condition	**#1**	**#2**	**#3**
Pump Capacity (gallons/minute)	7,000	8,700	11,000
Total Dynamic Head (TDH) (feet)	404	340	228
Minimum Pump Efficiency (percent)	79	85	76
Maximum NPSHr (feet)		18.5	

Pump Location	Transfer Pump Station
Number of Units	3
Designation/Tag Numbers	TP-601, TP-602, TP-603
Discharge Head Size (inches)	18 x 14 x 24.5,150 lb. Flg.
Minimum Column Diameter (inches)	18
Minimum Line Shaft Diameter (inches)	1.94
Bowl Assembly Diameter (inches)	24 (Nominal)
Suction Bell Diameter (inches)	24 O.D.
Suction Can Diameter (inches)	NA
Liquid Pumped	Potable Water
Temperature of Liquid Pumped	Ambient
Suction Condition	Flooded
Drive Type	Constant Speed
Minimum Stable Continuous Flow (gallons/minute)	2,219

Design Condition	**#1**	**#2**	**#3**
Pump Capacity (gallons/minute)	4,000	6,250	7,000
Total Dynamic Head (TDH) (feet)	102	78	61
Minimum Pump Efficiency (percent)	74	83	76
Maximum NPSHr (feet)		30.3	

Pump Location	Backwash Pump Station		
Number of Units	1		
Designation/Tag Numbers	BWP-702		
Discharge Head Size (inches)	20 x 20 x 24.5,150 lb. Flg.		
Minimum Column Diameter (inches)	20		
Minimum Line Shaft Diameter (inches)	2.6875		
Bowl Assembly Diameter (inches)	27 (Nominal)		
Suction Bell Diameter (inches)	27 O.D.		
Suction Can Diameter (inches)	NA		
Liquid Pumped	Potable Water		
Temperature of Liquid Pumped	Ambient		
Suction Condition	Flooded		
Drive Type	Constant Speed		
Minimum Stable Continuous Flow (gallons/minute)			
Design Condition	**#1**	**#2**	**#3**
Pump Capacity (gallons/minute)			
Total Dynamic Head (TDH) (feet)			
Minimum Pump Efficiency (percent)			
Maximum NPSHr (feet)			

2.2 PUMP CONSTRUCTION

A. Pump Bowls:

1. The bowls shall be of close-grained, gray cast iron, Class 30 or better, precision cast, free from blow holes, sand pockets, and other detrimental defects.
2. The water passageways in said bowls shall be smooth so as to allow freedom from cavitation and permit maximum efficiency.
3. Each bowl shall have a rubber lateral seal ring and a side seal to prevent slippage of water between bowl and impeller.

4. In order to improve the guaranteed efficiency at the design point(s), lined bowls shall be furnished.
    a. Said lining, vitreous porcelain enamel or equal, shall be of such material and applied in such manner to produce a long effective life which and shall not be applied for the purpose of a short time gain in efficiency.
    b. Lining, identical to that furnished hereunder, shall have been used in the field, under identical conditions, with satisfactory results for at least a five-year period. Lining shall be NSF 600 certified.
5. The outside diameter of the bowls shall be of such size to fit the suction can ID, with proper clearances while maintaining maximum velocity of less than 5 FPS between the pump can and bell, flange or coupling..
6. The bowl design pressure shall be a minimum of 3 1/2 times the maximum pump shut-off head (zero flow).
7. The exterior surfaces of the bowl assembly shall be coated with Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

B. Pump Impellers:
1. The impellers shall be of the enclosed type, constructed of Al Brz C952.
2. They shall be balanced hydraulically and dynamically to prevent vibration and shall be smoothly finished on all surfaces to reduce friction losses to a minimum. Dual plane balance to G6.3.
3. The impellers shall be accurately fitted and securely locked to the pump shaft, and vertical adjustment of the impellers shall be possible by means of an adjustment method in the driver assembly.
4. The split rings and keys for keyed impellers shall be constructed of 316 Stainless Steel.

C. Pump Shaft:
1. The pump shaft shall be constructed 416 Stainless Steel and shall be accurately machined to a sufficient dimension to provide smooth operation and to easily withstand torsional loads and other stresses encountered within the pump as calculated per AWWA E-103.
2. The pump shaft shall have adequate bearing support at every bowl section and at the top and bottom case section and shall be equipped with a suitable 410 Stainless Steel threaded coupling for connection to the line shaft.

D. Pump Bearings:
1. The suction case section and the discharge case section shall be sleeve type constructed of bismuth tin bronze.
2. The bowl bearings shall be sleeve type of bismuth tin bronze, or equal as approved by the engineer.
3. Bearing area, bearing cooling, and bearing lubrication shall be ample for long trouble-free operating life of the equipment.

E. Pump Suction Bell:
1. A suction bell constructed of class 30 Cast Iron shall be provided, with entrance vanes so designed to allow even flow of water into the pump.

F. Pipe Column:

1. The column shall be flanged. Hardware shall be 316 Stainless Steel.
2. The ends of the pipe section shall be faced parallel and machined to insure proper alignment when assembled.
3. Bearing spacing shall be no longer than 5 feet.
4. Intermediate connections to have a welded in steel bearing retainer and a Rubber bearing.
5. The exterior and interior surfaces of all column pipe shall be coated with Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.
6. Lining/coating shall be NSF 600 certified.

G. Pump Discharge Head Assembly:

1. The pump discharge head shall be of fabricated steel and shall be arranged for mounting, for connecting top column pipe, for connecting to the top of the can, and containing an above ground flanged discharge outlet.
2. A packed stuffing box shall be provided.
3. The exterior and interior surfaces of the discharge head shall be Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

H. Pump Line Shaft Assembly:

1. A line shaft shall be supplied, of Type 416 Stainless Steel material, or equal as approved by the Engineer, and shall conform to AWWA E-103.
2. Threaded shaft couplings of 410 SS shall be provided at all shaft connections.
3. Lubrication of the shafting will be with product lubrication.

I. Pump Nameplate:

1. The pump shall be provided with an easy to read, stainless steel nameplate.
2. It shall contain complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, TDH, and capacity in GPM at the middle design point, etc.
3. Said nameplate shall be mounted on the pump head.

J. Watertight Seal:

1. There shall be an appropriate seal installed between the suction can flange and the pump discharge head assembly to insure and provide a watertight seal.

K. Vortex Suppressor:

1. A 316 Stainless Steel vortex suppressor shall be provided and attached to the suction bell of the pump in order to prevent excessive turbulence in the water as it passes from the suction inlet pipe into the suction can, down between the bowl assembly and the suction can, and into the suction bell of the pump.

2.3 SUCTION CAN

A. This detailed specification is for requirements of pump suction cans used in conjunction with a line shaft vertical turbine close-coupled pump. The suction can shall be used with pump having a fabricated steel discharge head having above ground flanged discharge outlet. See Contract Drawings for reference.

B. Requirements:

1. Suction cans shall be sized as shown on the Drawings, and as specified herein.
2. Suction cans shall be equipped with the specified steel base flange, welded to top of can, designed for attachment of the pump discharge head.
3. Suction cans shall be equipped with 3/4-inch minimum thickness bottom plate, fully-welded (double pass) to bottom of can.
4. Inlet pipe to suction can shall be sized such that the maximum velocity is less than 4 FPS.

2.4 SPARE PARTS

A. Each pump shall be furnished with the following spare parts:

1. One (1) set of all bowl bearings
2. One (1) set of all wear rings
3. One (1) set of all pump shaft bearings
4. One (1) set of all gaskets and O-rings
5. Include any special tools required for normal maintenance

B. All spare parts furnished shall be identical and interchangeable with the original parts furnished in clearly identifiable and labeled containers.

C. Spare parts shall be packaged in suitable containers for extended storage in an indoor, non-climate controlled room.

2.5 ELECTRICAL AND CONTROL REQUIREMENTS

A. Provide all electrical components, wiring, and control devices necessary for a complete, functional system in accordance with the appropriate Sections of Division 26 – Electrical and Division 40 – Process Integration.

B. Electrical Requirements

Motors	
Rating	
High Service Pumps	4160V, 3 phase, 60 Hz
Transfer Pumps	460V, 3 phase, 60 Hz
Backwash Pump	460V, 3 phase, 60 Hz
Maximum Horsepower (hp)	
High Service Pumps	1,000
Transfer Pumps	150
Backwash Pump	60
Maximum Speed (revolutions/minute)	
High Service Pumps	1,190
Transfer Pumps	1,190
Backwash Pump	
Insulation	Class F

Inverter Duty	Yes
Service Factor	1.15
Resistance Temperature Detectors	Yes

C. Motor

1. Provide each pump with a motor in conformance with the most recent versions of applicable NEMA, IEEE, and ANSI standards.
    a. NEMA Design B.
2. Squirrel-cage induction-type.
3. Guaranteed for continuous operation without damage while non-submerged and pumping media of up to 40 degrees Celsius (104 degrees Fahrenheit) with an even 80 degrees Celsius (176 degrees Fahrenheit) temperature rise.
4. Motors Greater than 25 hp: Capable of sustaining a minimum of fifteen (15) starts per hour without overheating.
5. Rotor Bars and Short Circuit Rings: Cast aluminum.
6. Provided with pre-lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon the motor under all operating conditions.
7. Provide adequate motor horsepower so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
8. Motor Stator-Embedded Temperature Switches
    a. Equip each motor with two (2) or three (3) normally-closed thermal switches in series, one per phase, that are embedded in the stator end coils to monitor the temperature of each phase winding.
    b. Upon High Temperature: Switches open, activate an alarm, and stop the motor.
    c. Use switches in conjunction with and supplemental to external motor overload protection.
    d. Connect switches to control panel.
9. Seal off junction chamber from stator housing for connection of power and control cables.
    a. Not Acceptable: Using wire nuts or crimping-type connectors.
10. Not Acceptable: Using bolts, pins, or other fastening devices that require penetration of the stator housing.

2.6 SOURCE QUALITY CONTROL

A. Factory Pump Tests and Inspections

1. General:
    a. Pump(s) shall undergo factory non- witnessed pump testing.
    b. Tests shall be performed in accordance with the applicable standards in the Hydraulic Institute.
    c. The acceptance test shall be per Hydraulic Institute Acceptance grade 1U; with no minus tolerance on efficiency

d. To successfully pass a laboratory performance test, a pumping unit shall meet all performance requirements specified.

e. Generate a pump curve that shows actual flow, head, brake hp, and hydraulic efficiency for each pump furnished. Submit pump curves, each certified by a registered Professional Engineer, to the Owner.

2. Non-Compliance:

a. Should results of the test indicate, in the opinion of the Engineer, that the pumps fail to meet any of the specified requirements, the Owner will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional testing as may be necessary to comply with these specifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated on the Contract Drawings, unless otherwise approved by the Owner.

B. Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, vibration, shaft run-out or other defects. Equipment shall be secured in position and fixed neatly in appearance. Pumping unit shall be within 0.005" per foot of level at discharge head base.

C. All exposed materials except corrosion-resistant metals which have not been shop painted shall be field coated as specified (Protective Coating). Shop painted items which have been damaged during transport and/or installation, shall be touched up per specifications and as approved by Engineer.

D. The pump station construction Contractor shall furnish and install the reinforced concrete pedestal and all necessary embedment and support items as described on the Specifications and Contract Drawings.

E. The pump station construction Contractor will be responsible for coordinating all applicable aspects of the project with the pump and motor supplier including, but not limited to equipment installation procedures and requirements, specific materials to be furnished, scheduling of materials deliveries, overall construction schedule, equipment storage and protection requirements, and equipment testing requirements. The required coordination, including implementation of pump manufacturer’s requirements as related to the equipment furnished, shall be included in the construction Contractor’s bid price(s), and no additional compensation shall be made therefore.

3.2 FIELD QUALITY CONTROL

A. Field Tests and Inspections

1. Contractor shall provide system start-up and testing. The Pump Manufacturer or Approved Representative shall furnish the services of a qualified field engineer to check installation, start-up and instruct Owner operating personnel in the proper operation and maintenance of the equipment.

2. The Contractor under this specification shall have full responsibility for the proper installation and performance of said pumping equipment, including furnishing the services of a pumping equipment field Service Engineer to inspect during equipment

installation, and to adjust, if necessary, any portion of the pumping equipment required herein.

3. The Contractor's Field Service Engineer (Pump Manufacturer) shall be responsible for the pumping unit field acceptance tests. The pump unit(s) shall perform in the field substantially as shown on the certified pump curves furnished by the Contractor after reasonable allowances for field conditions. The head capacity, input horsepower, and overall efficiency values will be determined for at least three points in the stated operating range of the pump, and will be compared with the certified curves.
4. Field Service Engineer for Pump Manufacturer shall provide documentation to Engineer (including "Certification of Proper Installation") for all field adjustments made and tests performed.
5. In the event that the tests reveal noncompliance of the workmanship or equipment with these specifications, the Contractor shall be required to perform, at his own expense, such work and furnish materials as will, in the opinion of the Engineer, restore the equipment to the specified performance.
6. Final Acceptance Test
    a. Demonstrate pumps are properly installed and are in proper alignment.
    b. Demonstrate the pumps operate without overheating or overloading of any parts and without objectionable vibration.
        1) Vibration: Within the limits of the Hydraulic Institute Standards or the pump manufacturer's limits, if more stringent.
    c. Demonstrate the pumps meet the specified Design Conditions.
        1) Check each pump at maximum speed for a minimum of four (4) points on the pump curve for capacity, TDH, and amperage.
            a) Not Acceptable: Exceeding the rated current on the motor nameplate at any point.
            b) Motors Rated Less than 5 hp: Only test pump for overcurrent when overheating or other malfunction is evident during general testing.
7. Furnish all labor, materials, and test apparatus necessary for conducting the field tests at no additional cost to the Owner.

B. Manufacturer Services
1. The services described herein are for field installation and field acceptance testing as described in Par. 3.03 herein. For purposes of this paragraph, a work day is defined as an 8-hour period at the site, excluding travel time. The Owner may require that the manufacturer's services described herein be furnished in three (3) separate trips.
2. Furnish the field services of a qualified, trained, and competent manufacturer's technical representative who has knowledge of the proper installation, operation, and maintenance of the pumps in accordance with Section 01 43 33 – Manufacturer's Services. Include the following site visits for each series of pumps:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	3
Startup and Training	1	2

3. Manufacturer's Technical Representative's Minimum Responsibilities

a. Inspect the completed installation of each pump for conformance with manufacturer's recommended installation requirements. At a minimum, include the following:

1) Check proper rotation.

2) Check power supply voltage.

3) Measure motor no-load current.

4) Manually trip sensors and check complete cycle of control operation.

b. Supervise field test of each pump.

c. Supervise initial startup and operation of each pump.

d. Instruct Owner's personnel in proper operation and maintenance of pump.

e. Prepare and certify field inspection report.

3.3 ADJUSTING

A. After installation, align and adjust the pump and accessories as required for proper operation and proper alignment.

END OF SECTION 46 21 53

SECTION 46 21 54

VERTICAL TURBINE PUMPS - BACKWASH

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

Paragraph	Title
1.2	Administrative Requirements
1.3	Reference Codes and Standards
1.4	Submittals
1.5	Unit Responsibility
1.6	Delivery, Storage, and Handling
1.7	Field Conditions
1.8	Warranty
2.1	Equipment
2.2	Pump Construction
2.3	Suction Can
2.4	Spare Parts
2.5	Electrical and Control Requirements
2.6	Source Quality Control
3.1	Installation
3.2	Field Quality Control
3.3	Adjusting

B. Scope

1. This Specification is for Close-coupled water lubricated, vertical turbine pump installed in suction cans or wet well, as indicated on the Drawings, with above-ground flanged discharge and enclosed impellers. All parts of the pump exposed to water shall be of stainless steel, brass, heavy cast iron, or equivalent corrosion-proof material.
2. Furnish, install, provide start-up services, test, and place in satisfactory operation heavy-duty, electric, vertical turbine pumps for the locations identified in compliance with the Drawings and Specifications.
3. Unless otherwise specified herein, all applicable provisions of AWWA E-103 (Horizontal and Vertical Line Shaft Pumps), latest edition, are hereby made a part of these Specifications.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. The Contract Documents are intended to describe a pump installation for the specified purpose, complete and ready to be placed into service at the levels of performance indicated in the Drawings and outlined herein. By offering this service to the Owner, Contractor affirms that they are fully knowledgeable regarding the required methods and materials, and are capable of performing such installation. The omission of specific details and / or steps from the Drawings or Specifications, required to perform this installation shall not relieve the Contractor of their sole responsibility for this end result, nor shall such omissions be grounds for requests for additional compensation.
2. Coordinate with other manufacturers and suppliers to provide all details and appurtenances necessary to properly install, adjust, and place in satisfactory operation a complete working unit.

B. Definitions

1. The term “Pumping Unit” or “Units” shall be defined as a pump complete with motor, head assembly, bowl assembly, column assembly and other materials and components as described herein.

1.3 REFERENCE CODES AND STANDARDS

A. All equipment and materials shall meet the applicable provisions of the following reference codes and standards.

1. Hydraulic Institute (HI)
2. American Iron and Steel Institute (AISI)
3. American National Standards Institute (ANSI)
4. American Society of Testing and Materials (ASTM)
5. American Water Works Association (AWWA)
6. International Organization for Standardization (ISO)
7. Anti-friction Bearing Manufacturers Association (AFBMA)

1.4 SUBMITTALS

A. Action Submittals/Informational Submittals

1. Shop Drawings
   a. Submit the following items with the Shop Drawings in accordance with, or in addition to, the requirements specified in Section 01 33 23 – Shop Drawings, Product Data, and Samples and Section 01 60 00 – General Equipment Stipulations:
      1) Certified pump curves based upon factory testing by the pump manufacturer for approval by the Owner, for each pumping unit to be furnished herein; showing:
         a) Indicate flow, head, efficiency, brake horsepower, NPSHr, and minimum submergence.
         b) Each curve shall be continuous over the full operating range from zero (0) flow up to the maximum flow permissible through each pump, and each curve shall be based upon the RPM listed herein.
         c) For variable speed operation, if applicable, include curve for operation at the specified minimum RPM.

d) Each curve shall state the RPM speed of the pumping unit, and shall be furnished full-size on 8 1/2" x 11" paper.

e) Include limits (minimum and maximum flows) for stable operation without cavitation, overheating, recirculation, or excessive vibration.

f) Column and head losses, thrust data, etc.

g) Provide statement by Pump Manufacturer specifying the "Allowable Operating Range" as defined by the HI Standards and AWWA E-103 Standard.

2) Submit calculations and written certification from pump manufacturer that the pump furnished herein will operate compatible with the Net Positive Suction Head (NPSH) available.

3) General cutaway sections, materials, dimension of shaft projections, shaft and keyway dimensions, shaft diameter, dimension between bearings, general dimensions of pump, suction head bolt orientation, and anchor bolt locations and forces.

4) Detailed fabrication drawings of said pumping unit material and dimensioned installation drawings.

5) Detailed description of construction, including a parts list with materials of construction and metallurgy with ASTM designations.

6) Submit details of fabricated steel discharge head and provide written certification from pump manufacturer that the discharge head has the capability of accommodating the specified drives and the design column length within acceptable vibration limits.

7) Submit seismic calculations signed and stamped by an engineer.

8) Provide coating manufacturer's information and data for fusion bonded epoxy lining and coating.

9) Functional description of internal and external instrumentation and controls, including a list of parameters monitored, controlled, or alarmed.

10) Motor performance chart showing curves for torque, current, power factor, input/output power, and efficiency and data on starting and no-load characteristics.

2. Field and Test Procedures

a. Submit shop testing procedures at least thirty (30) days prior to the test.

b. Submit detailed field procedure for installation, adjustment, inspection, and testing of all pumping equipment.

3. Manufacturer Reports

a. Submit a certified report prepared by the manufacturer's technical representative certifying satisfactory installation, operation, and in-service placement of pumps.

B. Closeout Submittals

1. Operation and Maintenance Data

a. Submit Operating and Maintenance Manuals in accordance with Section 01 78 23 – Operating and Maintenance Data.

2. Warranty Documentation
    a. Include the manufacturer's warranty in the compiled warranty submittal of all manufacturers' warranties in accordance with Section 01 78 33 – Warranties and Bonds.

C. Maintenance Material Submittals
1. Spare Parts
    a. Include manufacturer's information for the spare parts specified herein with the Shop Drawing submittal.
2. Tools
    a. Include manufacturer's information for the special tools and supplies specified herein with the Shop Drawing submittal.

1.5 UNIT RESPONSIBILITY

A. General
1. The Pump Manufacturer shall be responsible for providing the pump, lineshaft, pump shaft, motor shaft (with bronze adjusting nut), column piping discharge head, and the motor as a complete unit to the Contractor for installation.
2. During the submittal process, the Pump Manufacturer shall provide a notarized certificate stating that all equipment and materials listed above will be provided by the Pump Manufacturer.
3. Pump Manufacturer or representative shall attend pump start-up and provide field services for assistance to the Contractor.

B. Compatible Equipment
1. All combinations of manufactured equipment which are approved under this specification shall be entirely compatible and the Contractor and the listed manufacturer shall be responsible for the compatibility and successful operation of the various components of the units conforming to the specified requirements.
2. All necessary mounting, couplings and appurtenances shall be included with each unit.
3. All materials employed in the pump equipment shall be suitable for the intended application and shall be high grade commercial quality, free from all defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
1. Ship components containing bearings with lubricant on all bearings.
2. Deliver all components to site in manufacturer's shipping crates or boxes.
3. Deliver to site undamaged.

B. Storage and Handling Requirements
1. Protect from corrosion and mechanical damage.
2. Protect electrical components from condensation.

3. Ship power and control cables with securely-attached caps on cable ends to prevent moisture wicking into cable during storage.
4. Store with lubricant on all bearings.
5. Handle all components in such a manner to prevent damage during unloading and installation.
6. Follow manufacturer's instructions regarding lifting and setting.

1.7 FIELD CONDITIONS

A. Ambient Conditions

1. Equipment Installation Location:
   a. Backwash Pumps: Outdoor installation through the top of a prestressed concrete clearwell.

1.8 WARRANTY

A. Manufacturer Warranty

1. Provide manufacturer warranty as specified in Section 01 78 33 – Warranties and Bonds with the exception that the warranty period is for two (2) years from the date of acceptance of the equipment.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Manufacturers

1. Manufacturer List
   a. Peerless
   b. Goulds
   c. Engineer approved equal
2. Substitution Limitations
   a. The naming of a manufacturer in this Section is not an indication that the manufacturer's standard equipment is acceptable in lieu of the specified component features. Naming is only an indication that the manufacturer may have the capability of engineering and supplying a system as specified.

B. Performance/Design Criteria

1. The pumps shall operate within the Hydraulic Institute standards and pump manufacturer's requirements under the design operating levels indicated on the Drawings. The Pump Schedule data below indicates the minimum hydraulic performance requirements for each pump (Design Condition #2).
2. Pump Schedule:

Pump Location	Backwash Pump Station
Number of Units	2
Designation/Tag Numbers	BWP-701 and BWP-702

Discharge Head Size (inches)	12 x 12 x 20, 150 lb. Flg.		
Minimum Column Diameter (inches)	12		
Minimum Line Shaft Diameter (inches)	1.19		
Bowl Assembly Diameter (inches)	15 (Nominal)		
Suction Bell Diameter (inches)	16.25 O.D.		
Suction Can Diameter (inches)	NA		
Liquid Pumped	Potable Water		
Temperature of Liquid Pumped	Ambient		
Suction Condition	Flooded		
Drive Type	Variable Frequency Drive		
Minimum Stable Continuous Flow (gallons/minute)			
Design Condition	**#1**	**#2**	**#3**
Pump Capacity (gallons/minute)		3,600	
Total Dynamic Head (TDH) (feet)		35	
Minimum Pump Efficiency (percent)		76	
Maximum NPSHr (feet)		14.2	

2.2 PUMP CONSTRUCTION

A. Pump Bowls:

1. The bowls shall be of close-grained, gray cast iron, Class 30 or better, precision cast, free from blow holes, sand pockets, and other detrimental defects.
2. The water passageways in said bowls shall be smooth so as to allow freedom from cavitation and permit maximum efficiency.
3. Each bowl shall have a rubber lateral seal ring and a side seal to prevent slippage of water between bowl and impeller. .
4. In order to improve the guaranteed efficiency at the design point(s), lined bowls shall be furnished.
   a. Said lining, vitreous porcelain enamel or equal, shall be of such material and applied in such manner to produce a long effective life which and shall not be applied for the purpose of a short time gain in efficiency.
   b. Lining, identical to that furnished hereunder, shall have been used in the field, under identical conditions, with satisfactory results for at least a five-year period. Lining shall be NSF 600 certified.
5. The outside diameter of the bowls shall be of such size to fit the suction can ID, with proper clearances while maintaining maximum velocity of less than 5 FPS between the pump can and bell, flange or coupling..
6. The bowl design pressure shall be a minimum of 3 1/2 times the maximum pump shut-off head (zero flow).

7. The exterior surfaces of the bowl assembly shall be coated with Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

B. Pump Impellers:

1. The impellers shall be of the enclosed type, constructed of Al Brz C952.
2. They shall be balanced hydraulically and dynamically to prevent vibration and shall be smoothly finished on all surfaces to reduce friction losses to a minimum. Dual plane balance to G6.3.
3. The impellers shall be accurately fitted and securely locked to the pump shaft, and vertical adjustment of the impellers shall be possible by means of an adjustment method in the driver assembly.
4. The split rings and keys for keyed impellers shall be constructed of 316 Stainless Steel.

C. Pump Shaft:

1. The pump shaft shall be constructed 416 Stainless Steel and shall be accurately machined to a sufficient dimension to provide smooth operation and to easily withstand torsional loads and other stresses encountered within the pump as calculated per AWWA E-103.
2. The pump shaft shall have adequate bearing support at every bowl section and at the top and bottom case section and shall be equipped with a suitable 410 Stainless Steel threaded coupling for connection to the line shaft.

D. Pump Bearings:

1. The suction case section and the discharge case section shall be sleeve type constructed of bismuth tin bronze.
2. The bowl bearings shall be sleeve type of bismuth tin bronze, or equal as approved by the engineer.
3. Bearing area, bearing cooling, and bearing lubrication shall be ample for long trouble-free operating life of the equipment.

E. Pump Suction Bell:

1. A suction bell constructed of class 30 Cast Iron shall be provided, with entrance vanes so designed to allow even flow of water into the pump.

F. Pipe Column:

1. The column shall be flanged. Hardware shall be 316 Stainless Steel.
2. The ends of the pipe section shall be faced parallel and machined to insure proper alignment when assembled.
3. Bearing spacing shall be no longer than 5 feet.
4. Intermediate connections to have a welded in steel bearing retainer and a Rubber bearing.
5. The exterior and interior surfaces of all column pipe shall be coated with Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.
6. Lining/coating shall be NSF 600 certified.

G. Pump Discharge Head Assembly:

1. The pump discharge head shall be of fabricated steel and shall be arranged for mounting, for connecting top column pipe, for connecting to the top of the can, and containing an above ground flanged discharge outlet.
2. A packed stuffing box shall be provided.
3. The exterior and interior surfaces of the discharge head shall be Tnemec 21 or approved equal with thickness and application procedures per paint manufacturer's published instructions.

H. Pump Line Shaft Assembly:

1. A line shaft shall be supplied, of Type 416 Stainless Steel material, or equal as approved by the Engineer, and shall conform to AWWA E-103.
2. Threaded shaft couplings of 410 SS shall be provided at all shaft connections.
3. Lubrication of the shafting will be with product lubrication.

I. Pump Nameplate:

1. The pump shall be provided with an easy to read, stainless steel nameplate.
2. It shall contain complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, TDH, and capacity in GPM at the middle design point, etc.
3. Said nameplate shall be mounted on the pump head.

J. Watertight Seal:

1. There shall be an appropriate seal installed between the suction can flange and the pump discharge head assembly to insure and provide a watertight seal.

K. Vortex Suppressor:

1. A 316 Stainless Steel vortex suppressor shall be provided and attached to the suction bell of the pump in order to prevent excessive turbulence in the water as it passes from the suction inlet pipe into the suction can, down between the bowl assembly and the suction can, and into the suction bell of the pump.

2.3 SPARE PARTS

A. Each pump shall be furnished with the following spare parts:

1. One (1) set of all bowl bearings
2. One (1) set of all wear rings
3. One (1) set of all pump shaft bearings
4. One (1) set of all gaskets and O-rings
5. Include any special tools required for normal maintenance

B. All spare parts furnished shall be identical and interchangeable with the original parts furnished in clearly identifiable and labeled containers.

C. Spare parts shall be packaged in suitable containers for extended storage in an indoor, non-climate controlled room.

2.4 ELECTRICAL AND CONTROL REQUIREMENTS

A. Provide all electrical components, wiring, and control devices necessary for a complete, functional system in accordance with the appropriate Sections of Division 26 – Electrical and Division 40 – Process Integration.

B. Electrical Requirements

Motors	
Rating	
Backwash Pump	460V, 3 phase, 60 Hz
Maximum Horsepower (hp)	
Backwash Pump	75
Maximum Speed (revolutions/minute)	
Backwash Pump	1,785
Insulation	Class F
Inverter Duty	Yes
Service Factor	1.15
Resistance Temperature Detectors	Yes

C. Motor

1. Provide each pump with a motor in conformance with the most recent versions of applicable NEMA, IEEE, and ANSI standards.
   a. NEMA Design B.
2. Squirrel-cage induction-type.
3. Guaranteed for continuous operation without damage while non-submerged and pumping media of up to 40 degrees Celsius (104 degrees Fahrenheit) with an even 80 degrees Celsius (176 degrees Fahrenheit) temperature rise.
4. Motors Greater than 25 hp: Capable of sustaining a minimum of fifteen (15) starts per hour without overheating.
5. Rotor Bars and Short Circuit Rings: Cast aluminum.
6. Provided with pre-lubricated radial and thrust bearings which are designed to carry the entire load which may be imposed upon the motor under all operating conditions.
7. Provide adequate motor horsepower so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
8. Motor Stator-Embedded Temperature Switches
   a. Equip each motor with two (2) or three (3) normally-closed thermal switches in series, one per phase, that are embedded in the stator end coils to monitor the temperature of each phase winding.
   b. Upon High Temperature: Switches open, activate an alarm, and stop the motor.
   c. Use switches in conjunction with and supplemental to external motor overload protection.
   d. Connect switches to control panel.
9. Seal off junction chamber from stator housing for connection of power and control cables.
   a. Not Acceptable: Using wire nuts or crimping-type connectors.
10. Not Acceptable: Using bolts, pins, or other fastening devices that require penetration of the stator housing.

2.5 SOURCE QUALITY CONTROL

A. Factory Pump Tests and Inspections

1. General:

a. Pump(s) shall undergo factory non- witnessed pump testing.

b. Tests shall be performed in accordance with the applicable standards in the Hydraulic Institute.

c. The acceptance test shall be per Hydraulic Institute Acceptance grade 1U; with no minus tolerance on efficiency

d. To successfully pass a laboratory performance test, a pumping unit shall meet all performance requirements specified.

e. Generate a pump curve that shows actual flow, head, brake hp, and hydraulic efficiency for each pump furnished. Submit pump curves, each certified by a registered Professional Engineer, to the Owner.

2. Non-Compliance:

a. Should results of the test indicate, in the opinion of the Engineer, that the pumps fail to meet any of the specified requirements, the Owner will notify the Contractor of such failure. The manufacturer shall thereupon, at no expense to the Owner, make such modifications and perform additional testing as may be necessary to comply with these specifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pumping equipment shall be installed in accordance with approved procedures submitted with the shop drawings and as indicated on the Contract Drawings, unless otherwise approved by the Owner.

B. Equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, vibration, shaft run-out or other defects. Equipment shall be secured in position and fixed neatly in appearance. Pumping unit shall be within 0.005" per foot of level at discharge head base.

C. All exposed materials except corrosion-resistant metals which have not been shop painted shall be field coated as specified (Protective Coating). Shop painted items which have been damaged during transport and/or installation, shall be touched up per specifications and as approved by Engineer.

D. The pump station construction Contractor shall furnish and install the reinforced concrete pedestal and all necessary embedment and support items as described on the Specifications and Contract Drawings.

E. The pump station construction Contractor will be responsible for coordinating all applicable aspects of the project with the pump and motor supplier including, but not limited to equipment installation procedures and requirements, specific materials to be furnished, scheduling of materials deliveries, overall construction schedule, equipment storage and protection requirements, and equipment testing requirements. The required coordination, including implementation of pump manufacturer’s requirements as related to the equipment furnished, shall be included in the construction Contractor’s bid price(s), and no additional compensation shall be made therefore.

3.2 FIELD QUALITY CONTROL

A. Field Tests and Inspections

1. Contractor shall provide system start-up and testing. The Pump Manufacturer or Approved Representative shall furnish the services of a qualified field engineer to check installation, start-up and instruct Owner operating personnel in the proper operation and maintenance of the equipment.
2. The Contractor under this specification shall have full responsibility for the proper installation and performance of said pumping equipment, including furnishing the services of a pumping equipment field Service Engineer to inspect during equipment installation, and to adjust, if necessary, any portion of the pumping equipment required herein.
3. The Contractor's Field Service Engineer (Pump Manufacturer) shall be responsible for the pumping unit field acceptance tests. The pump unit(s) shall perform in the field substantially as shown on the certified pump curves furnished by the Contractor after reasonable allowances for field conditions. The head capacity, input horsepower, and overall efficiency values will be determined for at least three points in the stated operating range of the pump, and will be compared with the certified curves.
4. Field Service Engineer for Pump Manufacturer shall provide documentation to Engineer (including “Certification of Proper Installation”) for all field adjustments made and tests performed.
5. In the event that the tests reveal noncompliance of the workmanship or equipment with these specifications, the Contractor shall be required to perform, at his own expense, such work and furnish materials as will, in the opinion of the Engineer, restore the equipment to the specified performance.
6. Final Acceptance Test
    a. Demonstrate pumps are properly installed and are in proper alignment.
    b. Demonstrate the pumps operate without overheating or overloading of any parts and without objectionable vibration.
        1) Vibration: Within the limits of the Hydraulic Institute Standards or the pump manufacturer’s limits, if more stringent.
    c. Demonstrate the pumps meet the specified Design Conditions.
        1) Check each pump at maximum speed for a minimum of four (4) points on the pump curve for capacity, TDH, and amperage.
            a) Not Acceptable: Exceeding the rated current on the motor nameplate at any point.
            b) Motors Rated Less than 5 hp: Only test pump for overcurrent when overheating or other malfunction is evident during general testing.
7. Furnish all labor, materials, and test apparatus necessary for conducting the field tests at no additional cost to the Owner.

B. Manufacturer Services

1. The services described herein are for field installation and field acceptance testing as described in Par. 3.03 herein. For purposes of this paragraph, a work day is defined as an 8-hour period at the site, excluding travel time. The Owner may require that the manufacturer's services described herein be furnished in three (3) separate trips.

2. Furnish the field services of a qualified, trained, and competent manufacturer's technical representative who has knowledge of the proper installation, operation, and maintenance of the pumps in accordance with Section 01 43 33 – Manufacturer's Services. Include the following site visits for each series of pumps:

Service	Number of Trips	Number of Days/Trip
Installation and Testing	1	3
Startup and Training	1	2

3. Manufacturer's Technical Representative's Minimum Responsibilities

   a. Inspect the completed installation of each pump for conformance with manufacturer's recommended installation requirements. At a minimum, include the following:

      1) Check proper rotation.

      2) Check power supply voltage.

      3) Measure motor no-load current.

      4) Manually trip sensors and check complete cycle of control operation.

   b. Supervise field test of each pump.

   c. Supervise initial startup and operation of each pump.

   d. Instruct Owner's personnel in proper operation and maintenance of pump.

   e. Prepare and certify field inspection report.

3.3 ADJUSTING

A. After installation, align and adjust the pump and accessories as required for proper operation and proper alignment.

END OF SECTION

APPENDIX A

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

AMERICAN IRON AND STEEL
SPECIAL CONDITIONS AND INFORMATION

For

FEDERALLY ASSISTED
STATE REVOLVING LOAN FUND
CONSTRUCTION CONTRACTS

April 11, 2014

The following standard language must be incorporated into construction contract documents and in all solicitations for offers and bids for all construction contracts or subcontracts to be funded, in whole or in part, through the Federally-assisted State Revolving Fund in the State of Georgia for projects subject to the American Iron and Steel requirements.

These Special Conditions shall not relieve the participants in this project of responsibility to meet any requirements of other portions of this construction contract or of other agencies, whether these other requirements are more or less stringent. The requirements in these Special Conditions must be satisfied in order for work to be funded with the State Revolving Fund.

TABLE OF CONTENTS

General Requirements	**GEFA/AIS-3**
Appendix 1 – Definitions	**GEFA/AIS-5**
Appendix 2 – Sample Certifications for Manufacturer Certification	**GEFA/AIS-8**
Appendix 3 – P.L. 113-76, Consolidated Appropriations Act, 2014	**GEFA/AIS-11**

GENERAL REQUIREMENTS

These Special Conditions are based on guidance provided by the United States Environmental Protection Agency (EPA). Public Law 113-76, the Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel" (AIS) requirement that requires State Revolving Loan Fund (SRF) assistance recipients to use iron and steel products that are produced in the United States for projects in this project. A copy of Section 436 of the Act is found in Appendix 3.

The products and materials subject to these requirements will be defined in Appendix 1 of these special conditions.

The Owner must maintain documentation of compliance with the AIS requirements. The documentation that the Owner maintains will be subject to review and audit by representatives of the state of Georgia, the EPA, the EPA Office of the Inspector General, and other federal authorities.

The Prime Contractor must provide certifications of compliance for all products subject to AIS requirements to the Owner prior to requesting payments for those products. The Owner or the Engineer may require certifications of compliance with submittals and shop drawings for these products as part of the submittal review process.

All manufacturing processes for a covered iron or steel product, as further defined in Appendix 1, must take place in the United States. If a covered product is taken out of the US for any part of the manufacturing process, it becomes foreign source material.

The EPA recommends the use of a step certification process to document the locations of the manufacturing processes involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer, processor, etc.) of the iron and steel products certifies that its step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification should include the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached in Appendix 2 is a sample step certification.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes for the product and for its iron and steel components occurred in the United States. The EPA states that additional documentation may be needed if the certification lacks important information and recommends step certification as the best practice. A sample final manufacturer certification is attached in Appendix 2.

The Prime Contractor may document that incidental and generally low cost components, as defined in Appendix 1, are compliant with AIS requirements under the De Minimis Waiver issued by the EPA. For these items, the Contractor must provide the Owner with documentation of costs for these items, including invoices, and a report of types and categories of materials to which the waiver is applied, the total cost of incidental components covered by the waiver for each category, and the calculations by which the total cost of materials incorporated into the project was determined. A sample De Minimis report is attached is Appendix 2.

Contractor, supplier, and manufacturer records are subject to review and audit by the EPA, its Inspector General, and other federal authorities.

Failure to comply with these requirements may delay, limit, or prevent the disbursement of SRF funds to the Owner. Violations of AIS requirements will require correction by the Contractor as determined by the Owner and Engineer, including replacement of deficient products with compliant products and compensation for costs and other damages that may result. Violations may also subject the Owner, the Contractor, and suppliers to other enforcement actions within the discretion of the EPA and other federal authorities.

The Act permits EPA to issue waivers for a case or category of cases in which EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent. The Contractor should notify the Owner and Engineer immediately if it finds that a waiver may be required.

By submitting a bid for this project and by executing this construction contract, the Contractor acknowledges to and for the benefit of the Owner and the state of Georgia that it understands that the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund or the Drinking Water State Revolving Fund and that Federal law authorizing these Funds contains provisions commonly known as "American Iron and Steel" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and the state of Georgia that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Owner or the state of Georgia. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or the state of Georgia to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or the state of Georgia resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the state of Georgia or any damages owed to the state of Georgia by the Owner). The Owner and the Contractor agree that the state of Georgia, as a lender to the Owner for the funding of its project, is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the state of Georgia.

Appendix 1 – Definitions

For purposes of the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the project:

Lined or unlined pipes or fittings;
Manhole Covers;
Municipal Castings (defined in more detail below);
Hydrants;
Tanks;
Flanges;
Pipe clamps and restraints;
Valves;
Structural steel (defined in more detail below);
Reinforced precast concrete (defined in more detail below); and
Construction materials (defined in more detail below).

Product primarily of Iron or steel: The product must be made of greater than 50% iron or steel, measured by cost. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required, except as required for reinforced precast concrete. If a product is composed of more than 50% iron or steel, but is not listed in Section 436 (a) (2) of the Act, it is not required to be produced in the US. Alternatively, the iron or steel in such a product can be sourced from outside the US.

Steel: An alloy that includes at least 50 percent iron and between 0.02 and 2 percent carbon and may include other elements. Other alloys of iron are not required to be produced in the US.

Produced in the United States: Production in the US of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

Municipal Castings: Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings include access hatches, ballast screen, benches, bollards, cast bases, cast iron hinged hatches, cast iron riser rings, catch basin inlets, cleanout/monument boxes, construction covers and frames, curb and corner guards, curb openings, detectable warning plates, downspout shoes, drainage grates, frames & curb inlets, inlets, junction boxes, lampposts, manhole covers, rings & frames, risers, meter boxes, steel hinged hatches, steel riser rings, trash receptacles, tree grates, tree guards, trench grates, and valve boxes.

Structural Steel: Structural steel is rolled flanged shapes, having at least one dimension of their cross-section 3 inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

Reinforced Precast Concrete: While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing rebar must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin. If the reinforced concrete is cast at the construction site, the reinforcing rebar is considered to be a construction material and must be produced in the US.

Construction Materials subject to AIS: Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". This includes, but is not limited to, the following products: welding rods, wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, gates, and screens.

Construction Materials not subject to AIS: Mechanical and/or electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples, including their appurtenances necessary for their intended use and operation, are NOT considered construction materials: pumps, motors, gear reducers, drives, variable frequency drives (VFDs), mixers, blowers/aeration equipment, compressors, meters, electric/pneumatic/manual accessories used to operate valves (such as valve actuators), gates, motorized screens (such as traveling screens), sensors, controls, switches, supervisory control and data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, dewatering equipment, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, and analytical instrumentation.

Items temporarily used during construction, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel. For example, trench boxes or scaffolding are not considered construction materials subject to AIS requirements.

Incidental Components compliant with AIS under the De Minimis Waiver: This waiver permits the use of de minimis incidental components that may otherwise be prohibited under AIS. These de minimis items may cumulatively comprise no more than a total of 5 percent of the total cost of the materials used in and incorporated into the project. The cost of an individual item may not exceed 1 percent of the total cost of the materials used in and incorporated into the project.

These items are miscellaneous, generally low-cost components that are essential for, but incidental to, the construction and are permanently incorporated into the project. For many of these incidental components, the country of manufacture and the availability of alternatives are not always readily or reasonably identifiable prior to procurement in the normal course of business. For other incidental components, the country of manufacture may be known, but the miscellaneous character in conjunction with the low cost, individually and in total, as typically procured in bulk, mark them as properly incidental. Examples of incidental components include small washers, screws, fasteners (i.e., nuts and bolts), miscellaneous wire, corner bead, ancillary tube.

Examples of items that are not incidental and are not covered by the De Minimis Waiver include significant process fittings (i.e., tees, elbows, flanges, and brackets), distribution system fittings and valves, force main valves, pipes for sewer collection and/or water distribution, treatment and storage tanks, large structural support structures.

Items covered as compliant under this waiver must be documented in a report to the Owner to demonstrate that they are both incidental and that they fall within the cost allowances of this waiver. The costs of these items must be documented by invoices. The report must include a listing of types and categories of materials to which the waiver is applied, the total cost of incidental components covered by the Waiver for each category, and the calculations by which the total cost of materials incorporated into the project was determined.

Appendix 2 – Sample Certifications
Step Certification

The following information is provided as a sample letter of step certification for American Iron and Steel compliance. Documentation must be provided on company letterhead. This is to be provided by each handler (supplier, fabricator, manufacturer, processor, etc.). Each time a step in the manufacturing process takes place, the handler delivers its work along with a certification of its origin.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Step Certification for Project (Insert project name and SRF number)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

List of items, products and/or materials:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Appendix 2 – Sample Certifications
Final manufacturer certification

The following information is provided as a sample letter of the final manufacturer to certify American Iron and Steel compliance for the entire manufacturing process. Documentation must be provided on company letterhead.

Date

Company Name
Company Address
City, State Zip

Subject: American Iron and Steel Certification for Project (Insert project name and SRF number)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement of P.L. 113-76 and as mandated in EPA's State Revolving Fund Programs.

List of items, products and/or materials:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Appendix 2 – Sample Certifications
Contractor De Minimis Report

Owner: (Owner Name)
SRF Project No: (SRF Number)
Project Description: (Contract title or brief description)
Date: (Date of report)
Submitted by (name & title): (Contractor representative)
Company Name

LIST OF MATERIALS OR CATEGORIES OF MATERIALS PERMANENTLY INCORPORATED INTO THE PROJECT	**COST**	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Category or Item	$1,000.00	
Total Permanent Materials	**$10,000.00**	
1 % of total material cost	**$100.00**	**Maximum cost for individual item waived**
5 % of total material cost	**$500.00**	**Maximum cumulative cost for category waived**

LIST OF MATERIALS OR CATEGORIES OF MATERIALS COVERED BY DE MINIMIS WAIVER	**COST**	**COMPLIANT (Yes/No)**
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Category or Item	$100.00	Yes
Total De Minimis Items	**$500.00**	Yes

INVOICES ATTACHED FOR DE MINIMIS ITEMS.

Appendix 3 – P.L. 113-76, Consolidated Appropriations Act, 2014

The Act states:

Sec. 436 (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term ''iron and steel products'' means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the ''Administrator'') finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

APPENDIX B

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

BUILD AMERICA, BUY AMERICA ACT
SPECIAL CONDITIONS AND INFORMATION
for
FEDERALLY ASSISTED
STATE REVOLVING LOAN FUND
CONSTRUCTION CONTRACTS

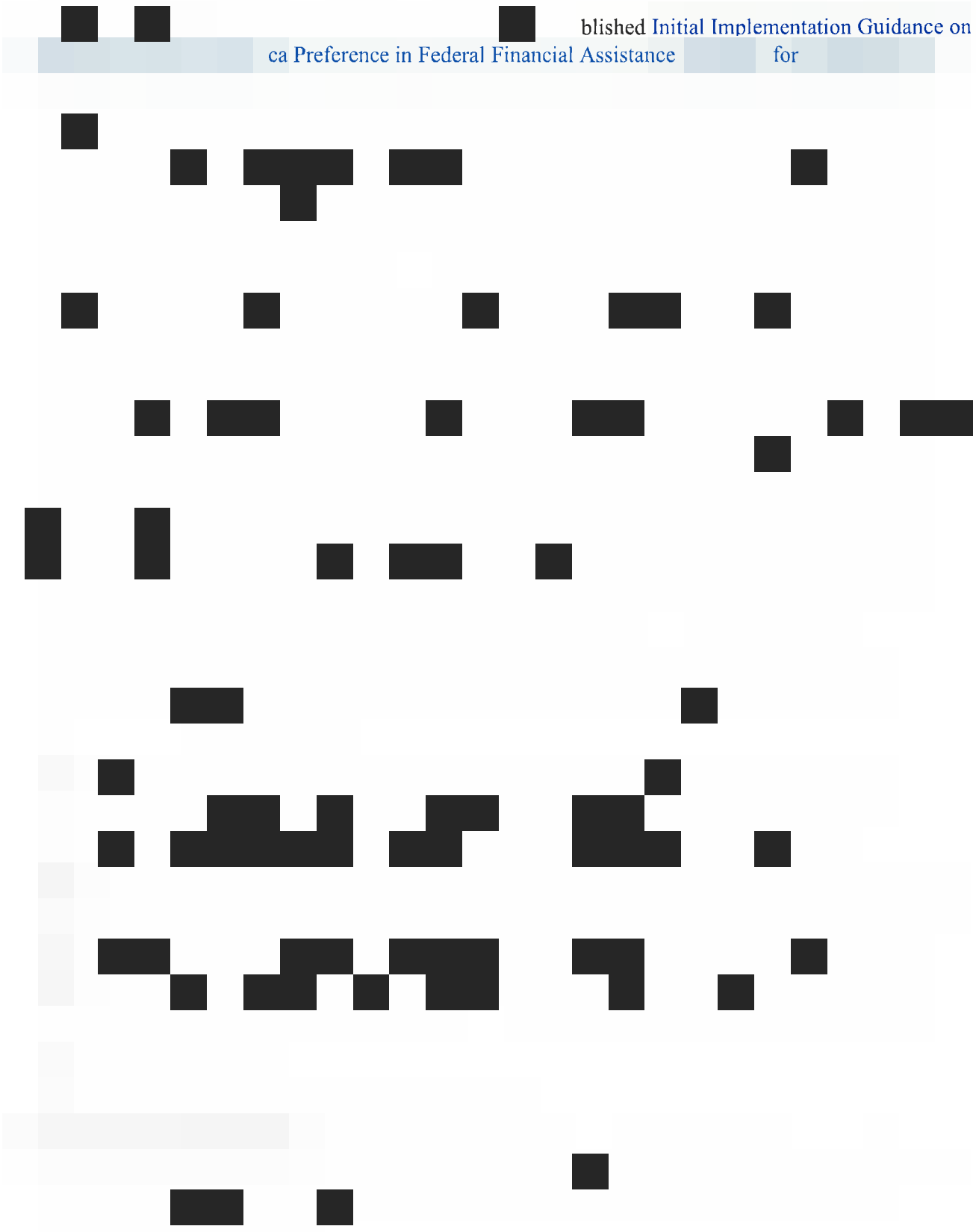
The following memorandum issued by the U.S. Environmental Protection Agency on November 3, 2022, provides implementation guidance for the Build America, Buy America Act (BABA). Exhibit D of the Georgia Environmental Finance Authority Loan Agreement requires compliance with BABA as needed. The following two links contain the required language for agreements.

Appendix 1 language is required to be inserted into construction contracts to comply with BABA.

Appendix 2 language is incorporated by reference into Exhibit D of GEFA's State Revolving Fund assistance agreements.



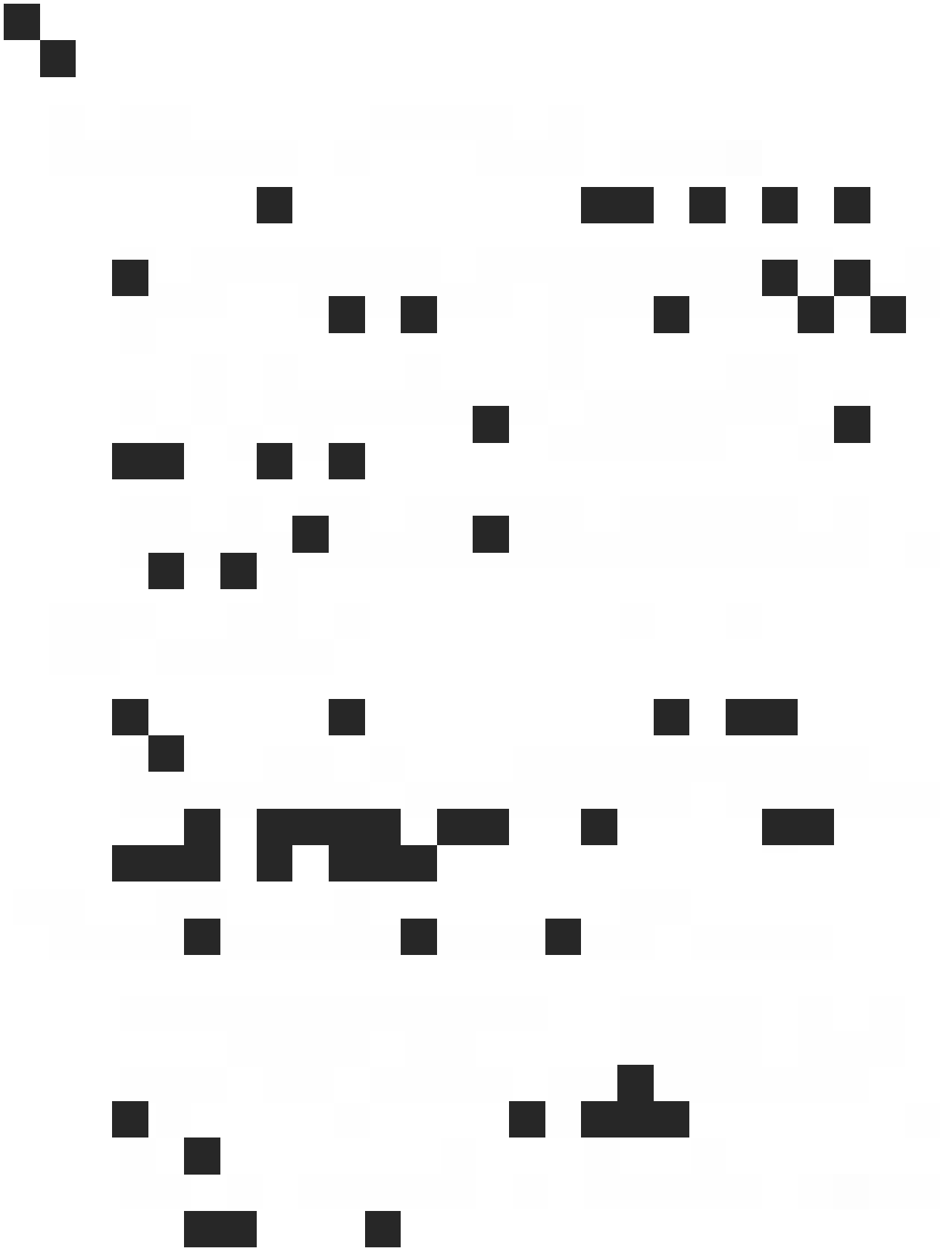
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



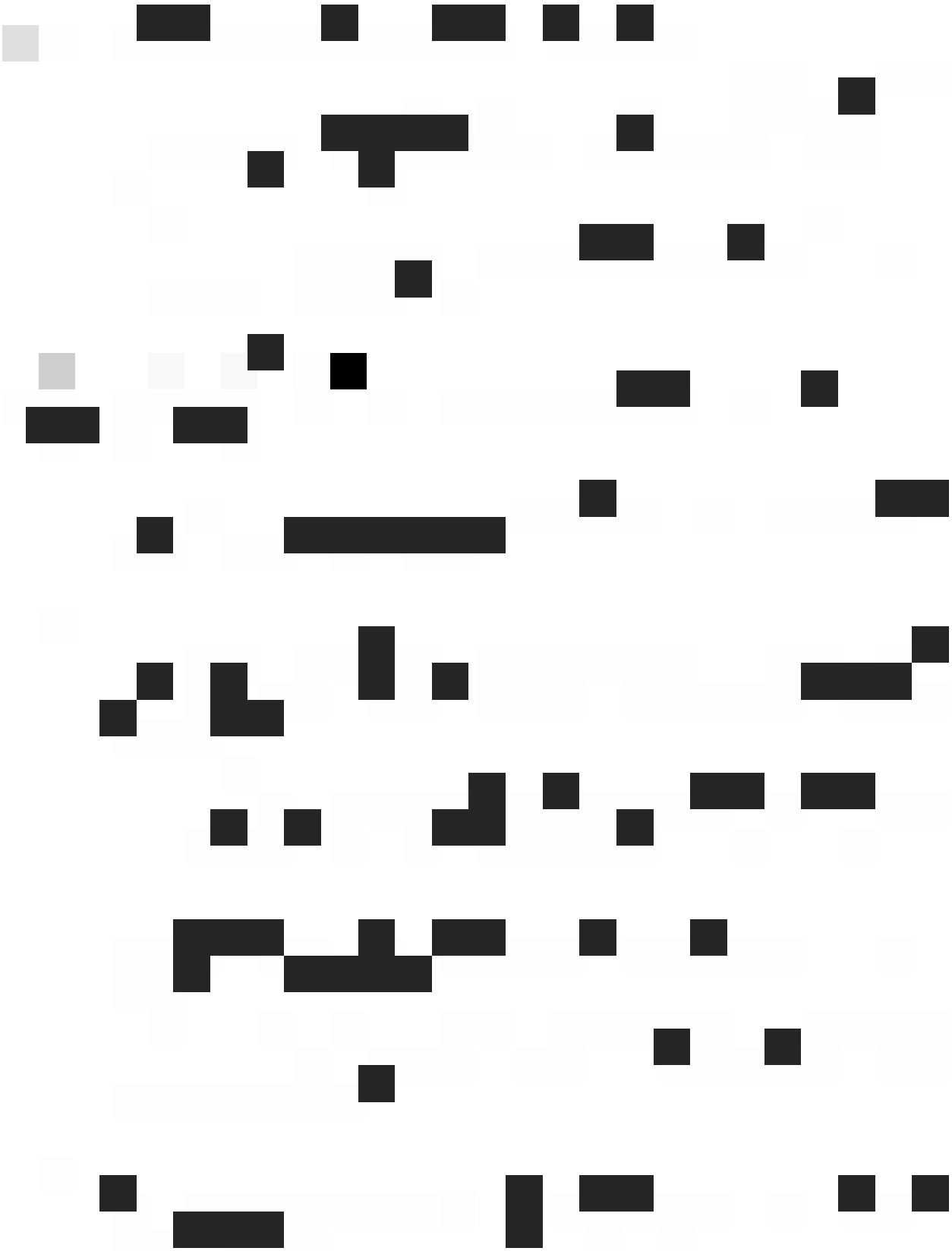
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS


Cranes



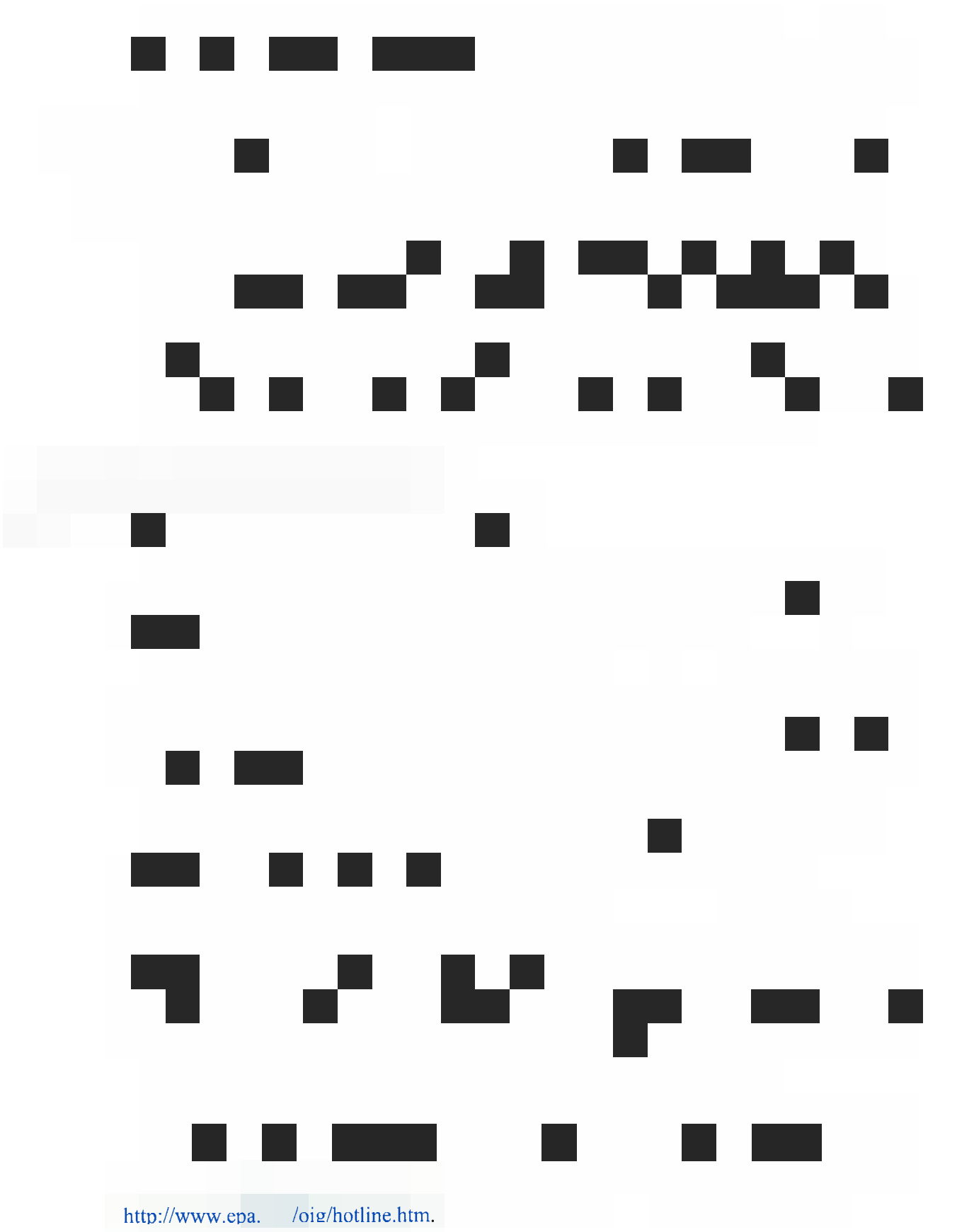
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS

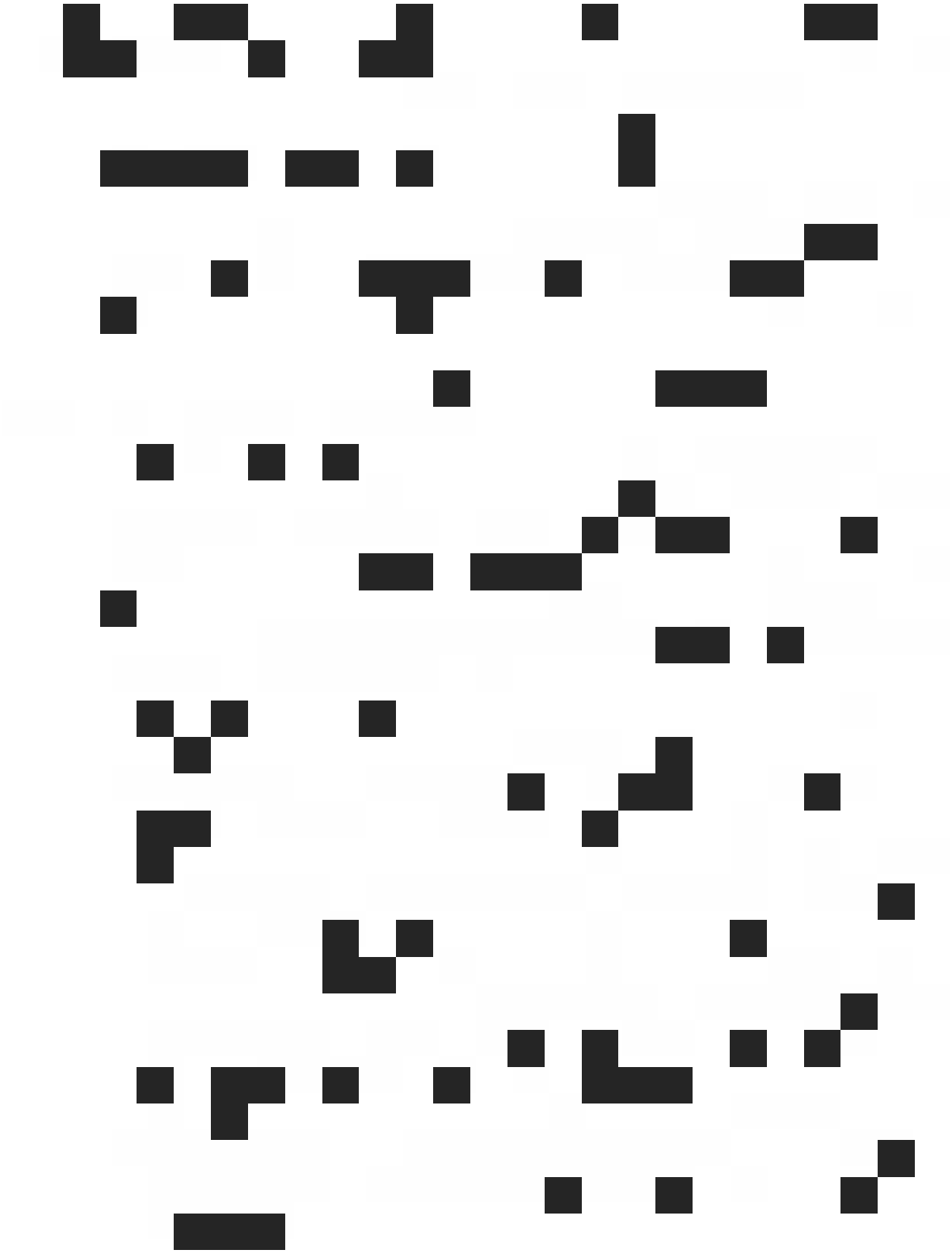


APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS

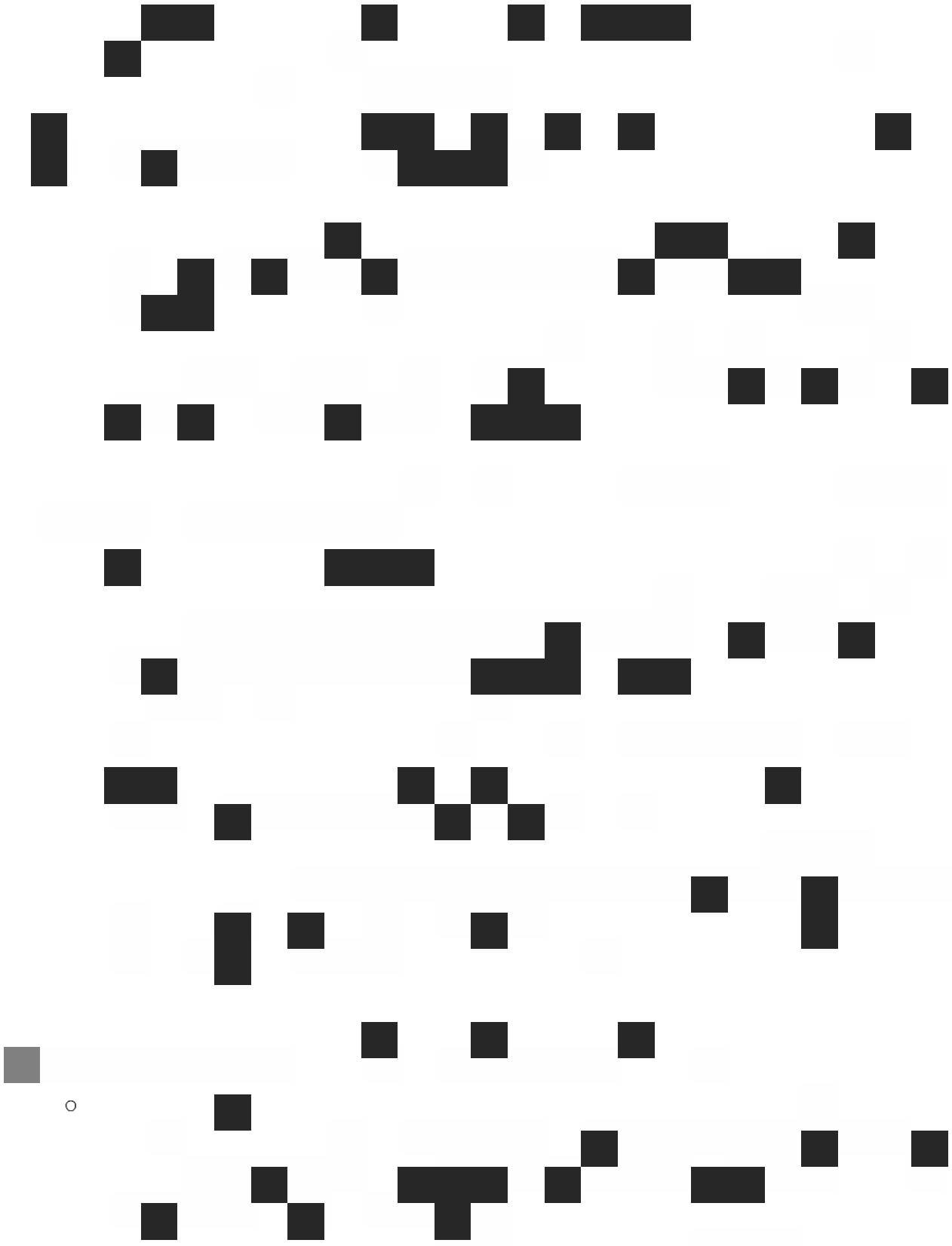

http://www.epa. /oig/hotline.htm.



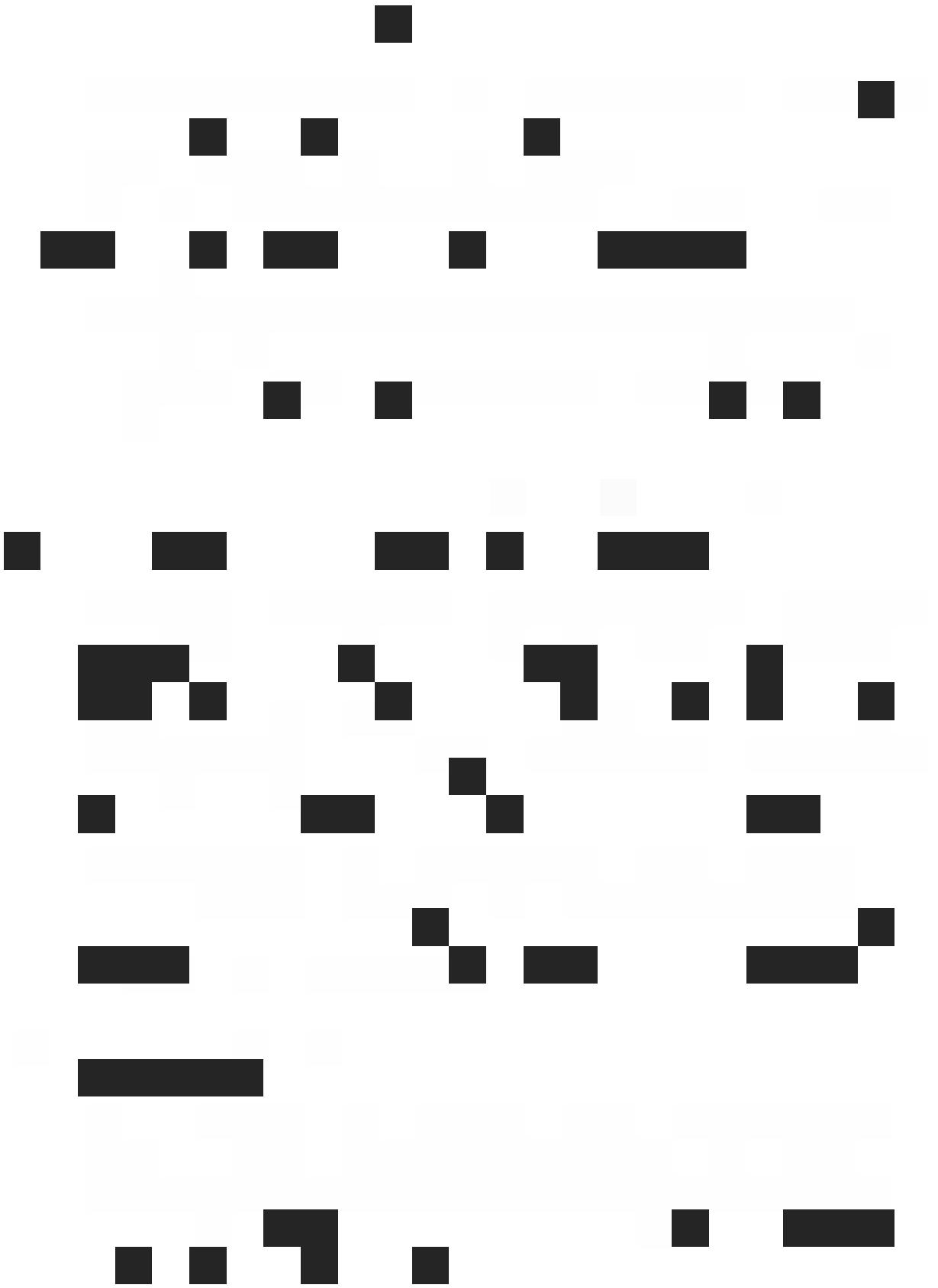
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



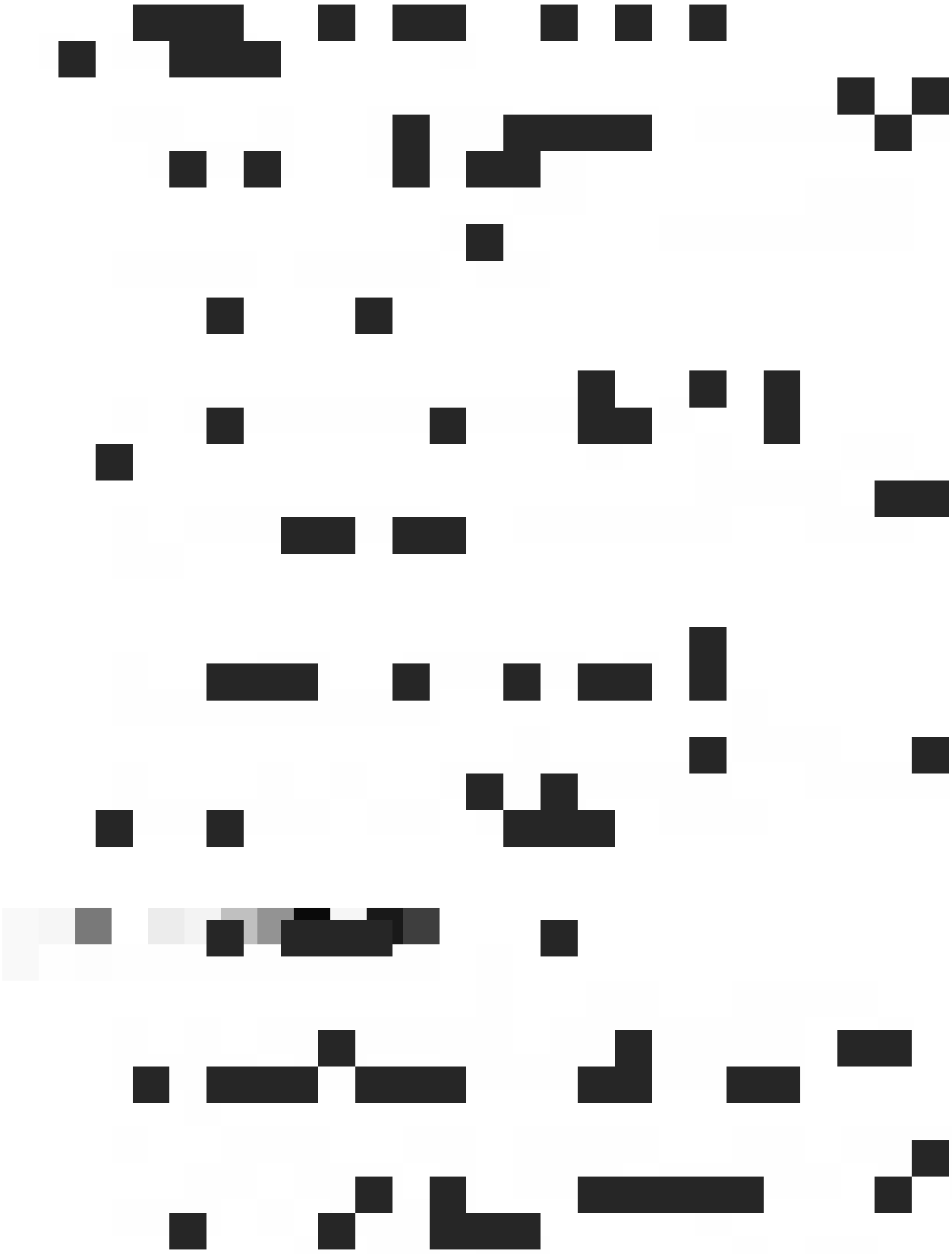
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



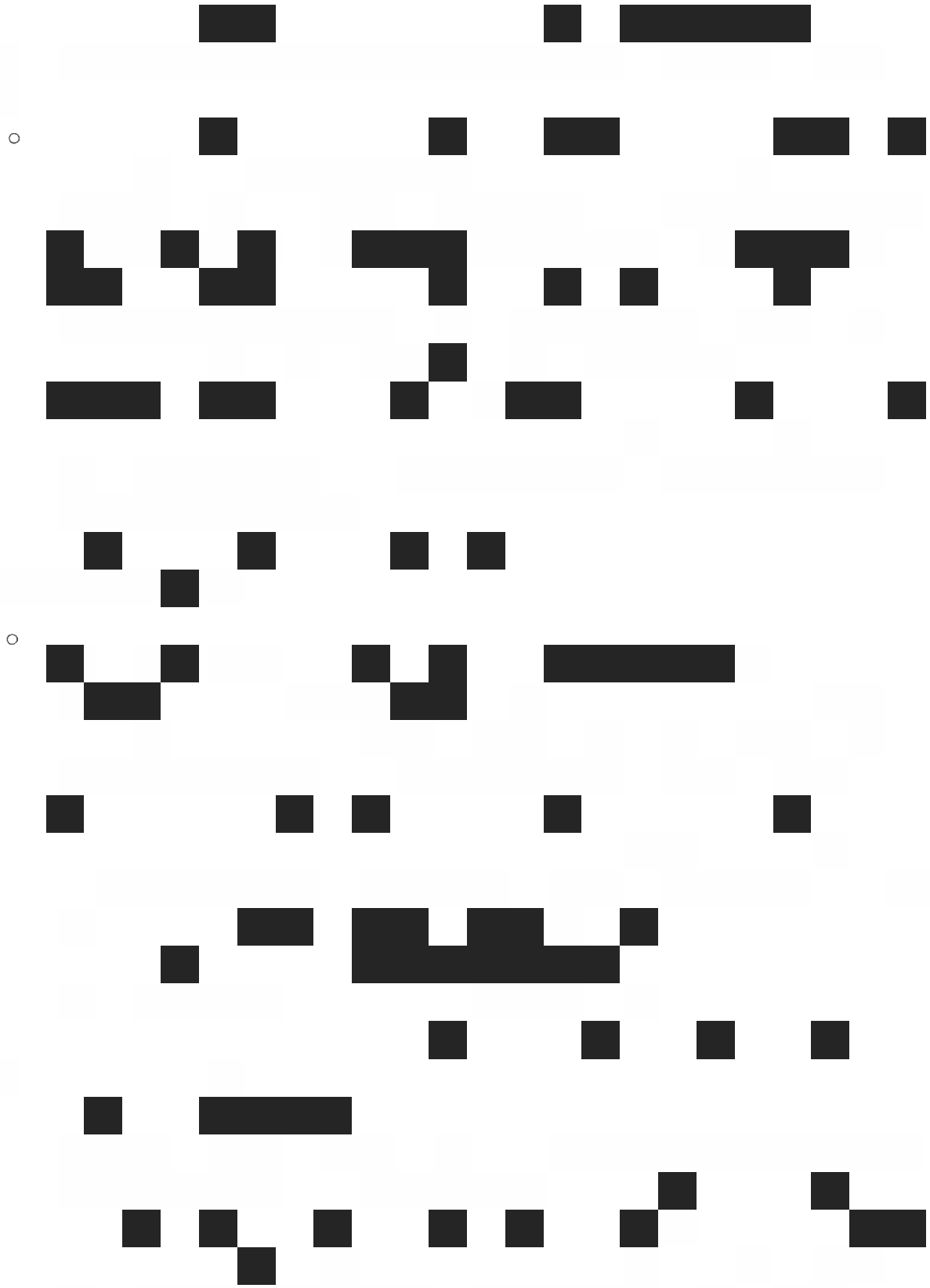
APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS

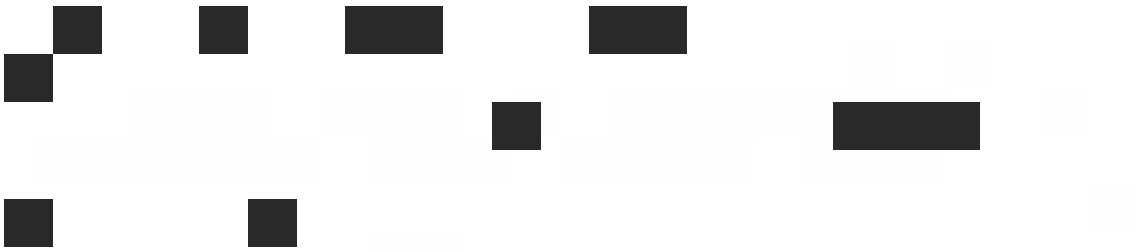


APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS

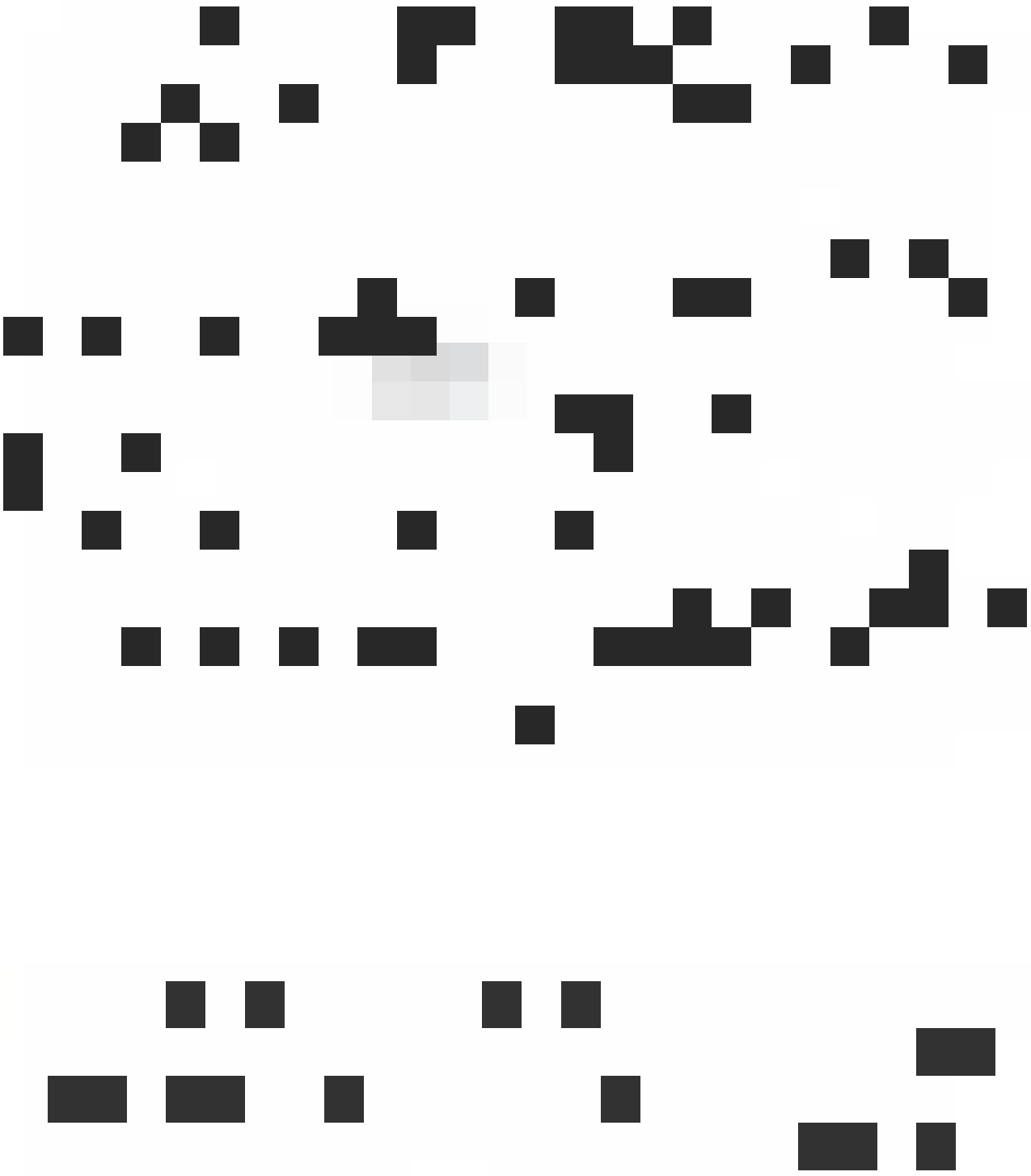

https://www.epa.gov/cwsrf/build-america-buy-america-baba-waivers-open-public-comment



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS



APPENDIX B - GEFA BUILD AMERICA, BUY AMERICA (BABA) CERTIFICATION AND SPECIAL CONDITIONS

APPENDIX C

GEORGIA ENVIRONMENTAL FINANCE AUTHORITY

SUPPLEMENTAL GENERAL CONDITIONS

for

FEDERALLY ASSISTED STATE REVOLVING FUND CONSTRUCTION CONTRACTS

December 7, 2022

The following standard language must be incorporated into construction contract documents and in all solicitations for offers and bids for all construction contracts or subcontracts in excess of $10,000 to be funded in whole or in part by the federally-assisted State Revolving Fund in the state of Georgia.

These Supplemental General Conditions shall not relieve the participants in this project of responsibility to meet any requirements of other portions of this construction contract or of other agencies, whether these other requirements are more or less stringent. The requirements in these Supplemental General Conditions must be satisfied for work to be funded with the State Revolving Fund.

TABLE OF CONTENTS

Instructions and General Requirements	3
DBE Compliance Form	4
DBE Compliance Checklist	6
Six Good Faith Efforts	7
Resources for Identifying DBE Subcontractors	8
Certification Regarding Equal Employment Opportunity	9
Certification Regarding Debarment, Suspension, and Other Responsible Matters	10
Changes to Approved Subcontractors Form	11
DBE Annual Report Form (5700-52A)	12
Special Provisions	13
Equal Employment Opportunity (EEO) Notice	14
EEO Construction Contract Specifications (Executive Order 11246)	15
Davis-Bacon and Related Acts	15
Wage Rate Determination (and links for forms, posters, etc.)	15
Certified Payroll Review Checklist	16

INSTRUCTIONS AND GENERAL REQUIREMENTS

It is the policy of the State Revolving Loan Fund (SRF) to promote a fair share of subcontract, materials, equipment, and service awards to small, minority, and women-owned businesses for equipment, supplies, construction, and services. Compliance with these contract provisions is required for project costs to be eligible for SRF funding. The fair share objective is a goal, not a quota. Failure on the part of the apparent successful bidder to submit required information to the loan recipient (Owner) may be considered by the Owner in evaluating whether the bidder is responsive to bid requirements.

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER:

A. Before beginning the work of any contract:

1) **DBE Compliance Form and related documentation.** The Owner must submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with Disadvantaged Business Enterprise (DBE) requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. (Pages GEFA-4 and 5)
2) **Certification Regarding Equal Employment Opportunity.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form, and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA-9)
3) **Certification Regarding Debarment, Suspension, and Other Responsible Matters.** This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor form should be submitted with the DBE Compliance Form and the subcontractor forms should be submitted as the subcontracts are executed. (Page GEFA-10)

B. During the performance of the contract:

4) **Changes to Subcontractors Form.** If any changes, substitutions, or additions are proposed to the subcontractors included in previous GEFA concurrences, the Owner must submit this information to GEFA for prior concurrence for the affected subcontract work to be eligible for SRF funding. (Page GEFA-11)
5) **DBE Annual Report.** The Owner must submit this information to GEFA no later than October 20 of any year that the construction contract is active. (Page GEFA-12)
6) **Certified Payrolls.** These should be submitted to the Owner weekly for the Prime Contractor and all subcontractors. The Owner must maintain payroll records and make these available for inspection. Use U.S. Department of Labor form WH-347 or a similar form that contains all the information on the U.S. Department of Labor.

THE OWNER MUST SUBMIT INFORMATION FOR GEFA REVIEW AND CONCURRENCE TO:

Georgia Environmental Finance Authority
47 Trinity Ave SW
Fifth Floor
Atlanta, Georgia 30334
404-584-1000 (phone)
404-584-1069 (fax)
waterresources@gefa.ga.gov

DBE COMPLIANCE FORM

ALL INFORMATION OUTLINED ON THIS FORM IS REQUIRED FOR DBE COMPLIANCE REVIEW. THE PROPOSED PRIME CONTRACTOR AND OWNER SHOULD ENSURE THAT THIS INFORMATION IS COMPLETE PRIOR TO SUBMITTAL.

Loan Recipient _____ **SRF Loan Number** _____

PRIME CONTRACTOR'S AND OWNER'S CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants and that EPA Forms 6100-2 and 6100-3 were distributed to all DBE subcontractors.

_____ **Date**_____
(Prime Contractor signature)

_____
(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

_____ **Date**_____
(Signature of Owner or Owner's representative)

_____
(Printed name and title)

CONTACT INFORMATION

Owner contact _____

Owner phone number and email _____

Consulting Engineer contact _____

Consulting Engineer phone number and email _____

Proposed Prime Contractor _____

Prime Contractor contact _____

Prime Contractor phone number and email _____

Proposed total contract amount $ _____

Proposed total MBE participation $ _____ **Percentage** _____ **Goal: 4.0 percent**

Proposed total WBE participation $ _____ **Percentage** _____ **Goal: 4.0 percent**

CONTINUED ON NEXT PAGE

Please submit the following with the DBE Compliance Form:

a. List of all committed and uncommitted subcontractors by trade, including company name, address, telephone number, contact person, dollar amount of subcontract, and DBE/MBE/WBE status.

b. Indicate in writing if no solicitations were made because the Prime Contractor intends to use only its own forces to accomplish the work.

c. Proof of certification by EPA, SBA, DOT (or by state, local, tribal, or private entities whose certification criteria match EPA criteria) for each subcontractor listed as a DBE, MBE, or WBE.

d. Documentation of solicitation efforts for prospective DBE firms, such as fax confirmation sheets, copies of solicitation letters and emails, printout of online solicitations, printouts of online search results, and copies and affidavits of publication in newspapers or other publications. (see also, "Six Good Faith Efforts", page GEFA-7).

   i. The Prime Contractor shall use the necessary resources to identify and directly solicit no less than three certified MBE firms and three certified WBE firms to bid in each expected subcontract trade or area. If a diligent and documented search of the recommended directories does not identify three potential certified MBE firms and three potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource.
   ii. The Prime Contractor is encouraged to follow-up each written, fax, or email solicitation with at least one logged phone call.
   iii. Whenever possible, post solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

e. Written justification for not selecting a certified DBE subcontractor that submitted a low bid for any subcontract area.

f. Certification By Proposed Prime Contractor or Subcontractor Regarding Equal Employment Opportunity (GEFA-9)

g. Certification By Proposed Prime or Subcontractor Regarding Debarment, Suspension, and Other Responsible Matters. (GEFA-10)

END OF DBE COMPLIANCE FORM

DBE COMPLIANCE CHECKLIST

THE PRIME CONTRACTOR MUST SUBMIT THE FOLLOWING ITEMS TO THE OWNER BEFORE THE WORK BEGINS:

Loan Recipient _____ **SRF Loan Number** _____

Include in Package Submittal

PRIME CONTRACTOR ONLY	TOTAL CONTRACT AMOUNT

ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT

ALL SUBCONTRACTORS, INCLUDING DBE FIRMS	TRADE	AMOUNT

DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT

DBE SUBCONTRACTORS ONLY	TRADE	AMOUNT

PRIME CONTRACTOR ONLY *(Not applicable if self-performing all work, with no subcontracting)*

1. DBE Compliance Form. The Owner must sign and submit this information to the Georgia Environmental Finance Authority (GEFA) to demonstrate compliance with DBE requirements. GEFA concurrence is recommended prior to award of the construction contract and is required prior to commencement of any SRF-funded construction. **(Pages GEFA-4 and 5**)

2. Certification Regarding Equal Employment Opportunity. This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-9)**

3. Certification Regarding Debarment, Suspension, and Other Responsible Matters. This form is required for the Prime Contractor and for all subcontractors. The Prime Contractor's form should be submitted with the DBE Compliance Form and the subcontractors' forms should be submitted as the subcontracts are executed. **(Page GEFA-10)**

Uncommitted Trades

Documentation of Good Faith Efforts

Newspaper ads		Internet Websites	Fax Confirmation	Copies of Solicitation Emails/letters	Copies of phone logs
PROOF OF CERTIFICATION FOR EACH SUBCONTRACTOR LISTED AS A DBE, MBE, OR WBE					

SIX GOOD FAITH EFFORTS

These good faith efforts are required methods to ensure that DBEs have the opportunity to compete for procurements funded by EPA financial assistance dollars. Such good faith efforts are described as follows:

1. Ensure DBEs are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. This will include placing DBEs on solicitation lists and soliciting them whenever there are potential sources.

2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. This will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5. Use the resources, services, and assistance of the U.S. Department of Transportation (DOT), U.S. Small Business Administration (SBA), and the Minority Business Development Agency of the U.S. Department of Commerce (MBDA).

6. If the Prime Contractor awards subcontracts, it must take the steps described in items (1) through (5) listed above.

Please note that DBEs, MBEs, and WBEs must be certified by EPA, SBA, or DOT (or by state, local, tribal, or private entities whose certification criteria match EPA's). DBEs must be certified to be counted toward the Prime Contractor's MBE/WBE goals. "Self-certified" DBE subcontractors will not be counted toward the Prime Contractor's MBE/WBE goals. Depending upon the certifying agency, a DBE may be classified as a DBE, a Minority Business Enterprise (MBE), or a Women's Business Enterprise (WBE).

The Prime Contractor must employ and document the **Six Good Faith Efforts** for all subcontracts, even if the Prime Contractor has achieved the fair share objectives.

The documentation of solicitations for the **Six Good Faith Efforts** must be detailed to allow for satisfactory review. Such documentation might include fax confirmation sheets, copies of solicitation letters/emails, printouts of the online solicitations, printouts of online search results, and affidavits of publication in newspapers or other publications. The Prime Contractor is encouraged to follow up each written, fax, or email solicitation with at least one logged phone call.

The Prime Contractor should attempt to identify and solicit DBEs in the geographic proximity of the project before soliciting those located farther away.

If a DBE subcontractor fails to complete work under the subcontract for any reason, the Prime Contractor must notify the Owner in writing prior to any termination and must employ the Six Good Faith Efforts described above if using a replacement subcontractor. Any proposed changes from the approved DBE subcontractor list must be reported to the Owner and to GEFA on the *Changes to Approved Subcontractors Form* (GEFA-14) prior to initiation of the action. EPA Forms Nos. 6100-3 and 6100-4 must also be submitted to GEFA for new DBE subcontracts.

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTORS

RESOURCES FOR IDENTIFYING DBE SUBCONTRACTOR'S FOR DIRECT SOLICITATION:

Georgia Department of Transportation (GDOT)
Disadvantaged Business Enterprise Program
404-631-1972
https://www.dot.ga.gov/GDOT/Pages/DBE.aspx

City of Atlanta, Georgia Office of Contract Compliance
404-330-6010
https://www.atlantaga.gov/government/mayor-s-office/executive-offices/office-of-contract-compliance

DeKalb County, Georgia
Office of Purchasing and Contracting
404-371-4730
http://dekalblsbe.info/wordpress1/wp-content/uploads/2016/05/DeKalbCountyCertifiedVendorsListMay10-2016-Final2.pdf

Fulton County, Georgia
Purchasing and Contract Compliance
404-612-5800

Metropolitan Atlanta Rapid Transit Authority (MARTA)
Disadvantaged Business Enterprise Program
404-848-4656

U.S. Environmental Protection Agency
http://www.epa.gov/osbp/dbe_team.htm

For more information about DBE compliance, contact:
waterresources@gefa.ga.gov

NOTES:

(1) The Prime Contractor shall use the necessary resources to identify and directly solicit no less than three certified MBE firms and three WBE firms to bid in each expected subcontract area or trade.
(2) If a diligent and documented search of the recommended directories does not identify three potential certified MBE firms and three potential certified WBE firms, then the Prime Contractor shall post an advertisement in the Owner's local legal organ, the Owner's official website, a regional newspaper in a larger community in the proximity, the Prime Contractor's website, or some other appropriate resource. Whenever possible, post solicitation for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.
(3) Expenditures to a DBE that acts merely as a broker or passive conduit of funds, without performing, managing, or supervising the work of its subcontract in a manner consistent with normal business practices may not be counted.
(4) The Prime Contractor should attempt to identify and first solicit DBEs in the geographic proximity of the project before soliciting those located farther away.
(5) Contact GEFA Project Managers at 404-584-1000 or waterresources@gefa.ga.gov for further assistance or resources.

CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR REGARDING EQUAL EMPLOYMENT OPPORTUNITY

Proposed Prime Contractor
Proposed Subcontractor

This certification is required pursuant to Executive Order 11246, Part II, Section 203 (b), (30 F.R. 12319-25), (as amended by EO 11375 of Oct. 13, 1967, 32 FR 14303, 3 CFR, 1966–1970 Comp., p. 684; EO 12086 of Oct. 5, 1978, 43 FR 46501, 3 CFR, 1978 Comp., p. 230, EO 13672 of July 21, 2104, 79 FR 42971). Any bidder or prospective prime contractor, or any of the proposed subcontractors, shall state as an initial part of the bid or negotiations of the contract whether it has participated in any previous contract or subcontract subject to the equal opportunity clause; and, if so, whether it has filed all compliance reports due under applicable instructions.

Where the certification indicated that the prime or subcontractor has not filed a compliance report due under applicable instruction, such contractor shall be required to submit a compliance report.

(1) Bidder has participated in a previous contract or subcontract subject to the Equal Opportunity Clause.
YES _____ NO _____

(2) Compliance Reports were required to be filed in connection with such contract or subcontract.
YES _____ NO _____ (If YES, state what reports were filed and with what agency.)

(3) Bidder has filed all compliance reports due under applicable instructions, including SF-100 (EEO-1 Report).
YES _____ NO _____ (If NO, please explain in detail.)

The information above is true and complete to the best of my knowledge and belief. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

_____
PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

_____ _____
SIGNATURE OF AUTHORIZED REPRESENTATIVE **DATE**

CERTIFICATION BY PROPOSED PRIME CONTRACTOR OR SUBCONTRACTOR REGARDING DEBARMENT, SUSPENSION, AND OTHER RESPONSIBLE MATTERS

Proposed Prime Contractor
Proposed Subcontractor

Under Executive Order 12549 individuals or organizations debarred from participation in federal assistance programs may not receive an assistance award under federal program or sub-agreement there under for $25,000 or more. Accordingly, each recipient of a state loan or a contract (engineering or construction) awarded under a loan must complete the following certification (see 2 CFR §1532.220).

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency.

(b) Have not within a three year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state, or local) transaction or contract under a public transaction; violation of federal or state antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (federal, state, or local) with commission of any of the offenses enumerated in paragraph (1) (b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (federal, state, or local) terminated for cause of default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. (A willfully false statement is punishable by law – U.S. Code, Title 18, Section 1001.)

_____

PRINTED NAME AND TITLE OF AUTHORIZED REPRESENTATIVE OF CONTRACTOR OR SUBCONTRACTOR

_____ _____

SIGNATURE OF AUTHORIZED REPRESENTATIVE **DATE**

_____ I am unable to certify to the above statements. My explanation is as follows:

CHANGES TO APPROVED SUBCONTRACTORS FORM

Loan Recipient _____ **SRF Loan Number** _____

CERTIFICATIONS:

I certify that the information submitted on and with this form is true and accurate and that this firm has met and will continue to meet the conditions of this construction contract regarding DBE solicitation and utilization. I further certify that criteria used in selecting subcontractors and suppliers were applied equally to all potential participants.

_____ Date_____
(Prime Contractor signature)

_____
(Printed name and title)

I certify that I have reviewed the information submitted on and with this form and that it meets the requirements of the Owner's State Revolving Fund loan contract.

_____ Date_____
(Signature of Owner or Owner's representative)

_____
(Printed name and title)

GENERAL INFORMATION:

1) If an approved subcontractor is terminated or replaced, please identify this company and briefly state reason.

Subcontractor Name:	**Trade**
Reason Terminated or Replaced	

2) For new or additional subcontractors, list name, trade, address, telephone number, contact person, dollar amount of subcontract, and DBE status.

New Subcontractor Name and Contact Person	**Trade**
Address	**Telephone Number**
Dollar Amount	**DBE Status**

1) Attach proof of certification by EPA, SBA, DOT (or by state, local, tribal, or private entities whose certification criteria match EPA's) for each subcontractor listed as a DBE, MBE, or WBE.

2) Attach documentation of Six Good Faith Efforts solicitation effort for all new subcontracts.

3) Provide justification for not selecting any certified DBE subcontractor that submitted a low bid for any subcontract area.

4) For each subcontractor, attach certifications regarding Equal Employment Opportunity (GEFA-9) and certifications regarding Debarment, Suspension, and Other responsible Matters (GEFA-10)

DBE ANNUAL REPORT
FORM (5700-52A)

This form must be completed by recipients of federal financial assistance for procurement of supplies, equipment, construction, or services. SRF loan recipients are required to submit this report to GEFA by the 20th of October for the previous period of October 1 through September 30. Please submit a "negative" report even if $0 is the amount paid to MBE/WBE subcontractors during the reporting period.

<table>
<tr><th colspan="4">ANNUAL REPORT FORM (5700-52A)</th></tr>
<tr><td colspan="2">1. PRIME CONTRACTOR</td><td colspan="2">2. REPORTING PERIOD (Complete date using current year.)
Period Ending (September 30, _____)</td></tr>
<tr><td colspan="2">3. SUBMIT TO:
Georgia Environmental Finance Authority
Attention: DBE Compliance Coordinator
47 Trinity Ave SW
Fifth Floor
Atlanta, Georgia 30303
waterresources@gefa.ga.gov</td><td colspan="2">4. LOAN RECIPIENT (Name, Address, and Telephone)</td></tr>
<tr><td>5. LOAN RECIPIENT (OWNER)
REPORTING CONTACT</td><td>PHONE:</td><td>6. TYPE OF FEDERAL FINANCIAL ASSISTANCE PROGRAM (Check one)
CWSRF _____ DWSRF_____</td><td>7. SRF LOAN NUMBER</td></tr>
<tr><td colspan="2">8. CONTRACTOR NAME AND TOTAL CONSTRUCTION CONTRACT AMOUNT</td><td colspan="2">9. ACTUAL DOLLAR AMOUNT PAIDTO MBE/WBE SUBCONTRACTORS THIS PERIOD
$ MBE_____ $ WBE_____ NEGATIVE REPORT ($0) ___</td></tr>
<tr><td colspan="2">10. RECIPIENT'S MBE/WBE GOALS
MBE 4.0 % WBE 4.0 %</td><td colspan="2">11. TOTAL DOLLARS SPENT THIS PERIOD
MBE $_____
WBE $_____
NON MBE/WBE $_____
TOTAL $ _____</td></tr>
<tr><td colspan="2">12. NAME AND TITLE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT (OWNER).</td><td>13. SIGNATURE OF AUTHORIZED REPRESENTATIVE OF LOAN RECIPIENT.</td><td>14. DATE</td></tr>
<tr><th colspan="4">MBE/WBE PAYMENTS MADE DURING PERIOD</th></tr>
<tr><td colspan="2">NAME AND ADDRESS of DBE (SUB)CONTRACTOR (indicate if MBE or WBE firm)</td><td colspan="2">TOTAL DOLLAR AMOUNT PAID AND DATE PAID
$_____ DATE_____</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td></tr>
</table>

SPECIAL PROVISIONS

(a) The Prime Contractor is required to pay its subcontractors in accordance with the Georgia Prompt Payment Act (OCGA 13-11).

(b) The Prime Contractor is required to insert the entirety of the Davis Bacon contract requirements into all subcontracts.

(c) Sewer line and water line crossing of all roads and streets shall be done in accordance with the Georgia Department of Transportation (D.O.T.) Policies and Procedures and must comply with the Ga. D.O.T. Standard Specifications, Construction of Roads and Bridges, 1993 Edition.

(d) Construction shall be carried out so as to prevent bypassing of wastewater flow and to prevent interruption of drinking water treatment during construction. EPD must receive written notification prior to any reduction in the level of treatment and must approve all temporary modifications to the treatment process prior to the activity.

(e) Erosion and Sedimentation Control shall be accomplished in accordance with the Georgia Erosion and Sedimentation Control Act of 1975 as currently amended and NPDES General Permits (Storm Water from Construction Sites). See also epd.georgia.gov and gaswcc.georgia.gov for information regarding permits.

(f) Use of Chemicals: All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer reactant or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in conformance with state and local regulations as appropriate.

(g) It is the duty of the Prime Contractor, the Owner and the Engineer to ensure the construction of the project, including the letting of contracts in connection therewith, shall comply with all applicable laws and regulations and requirements of the United States of America or any agency thereof, the state of Georgia or any agency thereof, territorial, or any local government laws or political subdivision and ordnances to the extent that such requirements do not conflict with federal laws and this subchapter.

(h) EPD, EPA, and GEFA shall have access to the site and the project work at all times.

BONDS

Bonding requirements for Contracts of $100,000 or less are contained in the General Conditions. Bond requirements of contracts in excess of $100,000 are:

1. Bid guarantee equivalent to five percent of the bid price. The bid guarantee shall consist of a firm commitment such as a certified check or bid bond submitted with the bid;

2. Performance bond equal to 100 percent of the contract price, and;

3. Payment bond equal to 100 percent of the contract price. Bonds must be obtained from companies holding Certificates of Authority as acceptable sureties, issued by the U.S. Treasury.

SPECIAL NOTICE TO BIDDERS

By the submission of this bid, each bidder acknowledges that he understands and agrees to be bound by the equal opportunity requirements of EPA regulations (40 CFR Part 8, particularly Section 8.4 (b)), which shall be applicable throughout the performance of work under any contract awarded pursuant to this solicitation. Each bidder agrees that if awarded a contract, it will similarly bind contractually each subcontractor. In implementation of the foregoing policies, each bidder further understands and agrees that if awarded a contract, it must engage in affirmative action directed at promoting and ensuring equal employment opportunity in the workforce used under the contract (and that it must require contractually the same effort of all subcontractors whose subcontracts exceed $10,000.00). The bidder understands and agrees that “affirmative action” as used herein shall constitute a good faith effort to achieve and maintain minority employment in each trade in the on-site workforce used on the project.

EQUAL EMPLOYMENT OPPORTUNITY NOTICE

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the Equal Opportunity Clause which is included in the nondiscrimination Provision and Labor Standards, EPA Form 5720-4 and the Standard Federal Equal Employment Opportunity (EEO) Construction Contract Specifications set forth herein.

2. The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	**4.0 percent**
Goals for female participation for each trade	**4.0 percent**

   These goals are applicable to all the Contractor's construction work (whether or not it is federal or federally assisted) performed in the covered area.

   The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals established for the geographical area where the contract resulting from this solicitation is to be performed. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minority and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation to the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The contractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40CFR Part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is (insert description of the geographical area where the contract is to be performed giving the state, county, and city, if any).

EEO Construction Contract Specifications

Executive Order 11246
https://www.dol.gov/agencies/ofccp/executive-order-11246/as-amended

Davis-Bacon and Related Acts
https://www.dol.gov/agencies/whd/government-contracts/construction

INSERT WAGE RATE DETERMINATION HERE

Wage Rates (for *Heavy Construction*) are state/county specific can be found at:
http://www.dol.gov/whd/govcontracts/dbra.htm

Sample Payroll Form (WH-347) is found at:
http://www.dol.gov/whd/forms/wh347.pdf

Labor Standards Interview Form (SF-1445) is found at:
http://www.gsa.gov/portal/forms/download/115910

Davis-Bacon (WH-1321) poster is found at:
http://www.dol.gov/whd/regs/compliance/posters/fedprojc.pdf (*English*)

http://www.dol.gov/whd/regs/compliance/posters/davispan.pdf (*Spanish*)

Fair Labor Standards Act Minimum Wage poster is found at:
http://www.dol.gov/whd/regs/compliance/posters/minwagebwp.pdf (*English*)

http://www.dol.gov/whd/regs/compliance/posters/minwagespbwP.pdf (*Spanish*)

"EEO Is the Law" poster is found at:
https://www.eeoc.gov/sites/default/files/2022-10/22-088_EEOC_KnowYourRights_10_20.pdf
(*English*)

https://www.eeoc.gov/sites/default/files/2022-10/22-088_EEOC_KnowYourRightsSp_10_20.pdf
(*Spanish*)

OSHA poster is found at:
https://www.osha.gov/sites/default/files/publications/osha3165.pdf
(*English*)

https://www.osha.gov/sites/default/files/publications/osha3167.pdf
(*Spanish*)

CERTIFIED PAYROLL REVIEW CHECKLIST

(This is a *recommended Certified Payroll Review Checklist for the Owner's use*.)

CONTRACT ID City of CW/DWSRF#00 - 000	**PRIME CONTRACTOR/SUBCONTRACTOR** X Construction
GENERAL WAGE DECISION AND DATE (Insert number and date)	**PAYROLL PERIOD ENDING**

INSTRUCTIONS: This checklist is to be used in conjunction with projects requiring Davis-Bacon Wage Rates and compliance reviews. All certified payrolls are to be date stamped upon receipt from the prime contractor.

Payroll Information Checklist:

_____ Prime Contractor's or subcontractor's name and address
_____ Contract ID numbers (GEFA SRF No.)
_____ Week ending.
_____ Project location.

_____ Employee ID or Last four digits of Social Security
- _____ Number Social Security Number removed
- _____ Employee's work classification
- _____ Identification of OJTs, apprentices, and program levels (%) on payrolls.
- _____ Verify that OJT and Apprentice Program documentation is in project files.

_____ Daily and weekly employee hours worked in each job classification.
- _____ Daily and weekly employee overtime (or premium) hours worked
- _____ Total weekly hours worked on all jobs (prevailing and non-prevailing wage).
- _____ Base rate shown for each employee, overtime (or premium) rate shown when worked.
- _____ Verify correct wage rates are being paid.
- _____ Verify overtime is being paid correctly (over 40 hrs/wk, and Time and a half)
- _____ Week's gross wages
- _____ Week's itemized deductions.
- _____ Week's net wages paid

_____ Compliance statement attached.
- _____ Method of fringe benefit payment described by checking either box (4)(a) or (4)(b).
- _____ Fringe benefit package information in file and updated as needed (if 4(a) is checked)
- _____ Exceptions explanation for fringe benefit (4)(c).
- _____ Signature.

Compliance Review Checklist (for field reviews):

_____ Verify work classifications reported are consistent with the work performed.
_____ Compare payrolls with wage rate interviews when conducted.
_____ Compare number of employees and hours worked with project documentation.

REVIEWED BY:	**DATE**

APPENDIX D

General Decision Number: GA20240288 01/05/2024

Superseded General Decision Number: GA20230288

State: Georgia

Construction Type: Heavy

County: Forsyth County in Georgia.

HEAVY CONSTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least $16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least $12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number Publication Date

0 01/05/2024 SUGA2017-003 04/15/2021

	Rates	Fringes
CARPENTER (Form Work Only)	$ 19.99	0.00
CARPENTER, Excludes Form Work	$ 21.64	3.90
CEMENT MASON/CONCRETE FINISHER	$ 19.02	3.29
ELECTRICIAN	$ 28.39	9.15
LABORER: Common or General	$ 13.98 **	1.38

LABORER: Pipelayer	$ 18.29	4.73
OPERATOR: Backhoe/Excavator/Trackhoe	$ 24.17	4.70
OPERATOR: Bulldozer	$ 16.29**	0.00
OPERATOR: Crane	$ 25.45	0.00
OPERATOR: Loader	$ 17.86	0.65
OPERATOR: Roller	$ 11.89 **	0.00
PIPEFITTER	$ 24.72	13.82

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 ($17.20) or 13658 ($12.90). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers:

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that

classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers:

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers:

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- an existing published wage determination
- a survey underlying a wage determination
- a Wage and Hour Division letter setting forth a position on
- a wage determination matter
- a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey

program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==========

END OF GENERAL DECISION

APPENDIX E

STATE REVOLVING FUND SUBRECIPIENT REPORT OF COMPLIANCE WITH DAVIS-BACON LABOR STANDARDS PROVISIONS FOR FEDERALLY ASSISTED CONTRACTS

Owner/Jurisdiction:
SRF Loan No:
Project Description:

This form will be submitted with or prior to the loan recipient's first request for funding of construction costs, prior to final disbursement of funds from the loan, and as requested by the State during the project.

Subrecipient (SRF loan recipient) Statement:
I confirm that to the best of my knowledge and belief that we are in compliance with the requirements of 29 CFR 5.5(a)(1), as referenced in the following requirements of the Davis Bacon Act, USEPA guidance, and the State Revolving Fund grant agreement between USEPA and the State of Georgia.

_____ _____
Signature (Owner/Owner Representative) Date

USEPA Requirements (from Davis Bacon Act, USEPA guidance, SRF grant agreement):

2. Obtaining Wage Determinations
(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.
(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.
(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.
(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.
(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract Provisions

(a) (3)(i) As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week.

5. Compliance Verification (from Davis Bacon Act, USEPA guidance, SRF grant agreement)

(a). The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c). The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d). The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at http://www.dol.gov/esa/contacts/whd/america2.htm. above.

APPENDIX F

GEOSYSTEMS
ENGINEERING, INC.

GEOTECHNICAL EXPLORATION REPORT

CITY OF CUMMING
PROPOSED PWPF CLEARWELL IMPROVEMENTS
FORSYTH COUNTY, GEORGIA

Prepared for:

CITY OF CUMMING UTILITIES
100 MAIN STREET, SUITE 401
CUMMING, GEORGIA 30040

GEOSYSTEMS PROJECT NO. 25-3003
JANUARY 29, 2026

GEOSYSTEMS
ENGINEERING, INC.

January 29, 2026

Ms. Christa Hopkins
City Engineer
Cumming Utilities
100 Main Street, Suite 401
Cumming, Georgia 30040

Re: Geotechnical Exploration Report
City of Cumming
PWPF Clearwell Improvements
Forsyth County, Georgia
GeoSystems Proposal No. 25-3003

Dear Ms. Hopkins:

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for the proposed City of Cumming PWPF Clearwell Improvements. The primary purpose of the exploration was to characterize subsurface conditions at the site and provide recommendations for foundation design and construction of the new structures. The enclosed report describes our field investigation and engineering evaluation procedures and presents the site and subsurface conditions encountered along with our recommendations.

Thank you for giving us the opportunity to conduct this geotechnical exploration. We look forward to assisting you with any additional geotechnical evaluations that may be required in the future. If you have any questions concerning this report or need anything further, please call us.

Sincerely,

GeoSystems Engineering, Inc.



Larry D. Mullins, P.E.
Principal Engineer

Andy R. Christian
Staff Engineer

TABLE OF CONTENTS

Page

INTRODUCTION 1

Background 1
Purpose 1
Scope of Work 1
Authorization 1

EXPLORATION PROCEDURES 2

SITE CONDITIONS 3

AREA AND SITE GEOLOGY 3

SUBSURFACE CONDITIONS 5

Phase 2 Clearwell Improvements 5
Phase 2B High Service Pump Station & Future Phase 4 Clearwell 6

PROJECT INFORMATION 7

DESIGN & CONSTRUCTION RECOMMENDATIONS 8

Seismic Site Classification 8
Site Preparation 8
Earthwork 8
Foundation Support 9
Foundation Inspection 12
Slope Stability 12
Retaining/Below Grade Walls 12

QUALIFICATION OF RECOMMENDATIONS 14

TABLE OF CONTENTS (Continued)

APPENDIX A: FIELD AND LABORATORY PROCEDURES
APPENDIX B: FIGURE 1 - BORING LOCATION PLAN
FIGURE 2 – SUBSURFACE PROFILES
FIGURE 3 – SUBSURFACE PROFILES
FIGURE 4 - SUBSURFACE PROFILES
KEY TO SYMBOLS AND CLASSIFICATIONS
BORING LOGS (17)
APPENDIC C: 2006 SUBSURFACE INVESTIGATION REPORT

INTRODUCTION

Background

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized geotechnical exploration for the planned clearwell improvements to the City's existing potable water production facility (PWPF). The project includes two 160-foot diameter, 6.0-million gallon (MG) clearwells (Phase 2 and future Phase 4), a high service pump station and an electrical building. Phase 2 and Phase 2B construction includes one clearwell, the electrical building, and the high service pump station. The second clearwell will be added in the future Phase 4 construction.

The existing PWPF is located on the west side of Dahlonega Road (Georgia Highway 9) at Sawnee Creek. The facility is 1½ to 2 miles northeast of downtown Cumming and about ½-mile north of Sawnee Drive. The planned clearwell improvement structures will be constructed in an undeveloped wooded area in the northwest corner of the existing PWPF immediately west of an existing 2.0-MG clearwell. The Phase 2 clearwell and electrical building are partially located within an old undocumented fill area that was previously addressed as part of subsurface investigation conducted by Geosystems in 2006 (Geosystems Project No. 06-1899). In addition to our current geotechnical exploration data, we have relied on the subsurface conditions indicated by the previous investigation soil test borings in evaluating geotechnical design and construction measures for this project.

Purpose

The primary purpose of this exploration was to characterize subsurface conditions at the clearwell improvements site and provide foundation design and construction recommendations for the new structures.

Scope of Work

The scope of work for the geotechnical exploration included visual inspections of the site, clearing of trees and underbrush to provide drill rig access to the boring locations, drilling seventeen soil test borings in the field, standard penetration testing and collection of split-spoon soil samples in the borings, evaluation of the boring data, and preparation of this report. The City of Cumming Utilities staked the boring locations in the field and determined the ground surface elevation at each boring location for our exploration prior to the site clearing. We have also reviewed available geologic information, historic aerial photographs, and on-line site specific soil survey data for the clearwell improvements site from the NRCS website.

Authorization

Formal written authorization for the exploration was provided by Mr. Jonathon W. Heard, Director of Utilities, on October 22, 2025. At that time, Mr. Heard signed our standard "Agreement for Limited Professional Services" contract form on behalf of the City.

EXPLORATION PROCEDURES

The soil test borings for this project (B-1 through B-17) were drilled at the approximate locations shown on the enclosed boring location plan (Figure 1). Locations of borings previously completed for Geosystems Project No. 06-1899 in 2006 (B-1 through B-8) are also included on Figure 1 using a different symbol for the borings. The boring location plan was produced from an electronic copy of the *Master Plan Option 2* that was provided to us. Site topography in the Phase 4 clearwell area was plotted on the plan using available Forsyth County GIS data.

Current exploration borings were drilled at the locations staked in the field by the City of Cumming Utilities. Ten soil test borings (B-1 through B-10), four on the perimeter and one at the center of each clearwell, were completed to auger refusal depths varying from 25 to 67 feet below ground surface (bgs). These relatively deep borings were required to determine the total thickness of compressible soils required for evaluation of the clearwell settlement. Four soil test borings (B-11 through B-14) at the corners of the high service pump station and three (B-15 through B-17) at the corners of the electrical building were also completed. The pump station borings were drilled to auger refusal depths varying from 16 to 26 feet bgs and the electrical building borings were extended to planned termination depths of 40 feet. Elevations of these borings were rounded to the nearest 1.0-foot elevation increment from the ground elevations that were labeled on the survey stakes. In some cases, the survey boring elevations diverge significantly from the contour elevations included on the provided *Master Plan Option 2*.

The borings were advanced by mechanically rotating hollow-stem augers into the ground to the boring termination or refusal depths noted above. Soil samples were obtained in the borings by conducting standard penetration tests (SPTs) at regular intervals using a standard 1.4-inch I.D., 2-inch O.D. split-spoon sampler. The sampler was first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the final foot was recorded and is designated the "standard penetration resistance" or the "N" value. Penetration resistance, when properly evaluated, is an indication of the soil's strength and support capability.

The split-spoon soil samples collected from the borings were initially classified, groundwater levels were recorded and logs of the borings were initially prepared by the driller at the time of the field investigation. On completion of the field investigation all borings were closed by backfilling the open boreholes with the drill soil cuttings.

In the laboratory, the field logs were reviewed, all split-spoon soil samples were visually classified by a geotechnical engineer, and final detailed logs of the borings and subsurface profiles were prepared. The soil test boring logs and subsurface profiles represent our interpretation of the field subsurface conditions. Included on the boring logs are visual soil descriptions, unified classifications, graphical plots of the standard penetration resistances, and groundwater conditions encountered at the time of the field investigation. The lines on the boring logs designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual.

All drilling and sampling operations were conducted in general accordance with ASTM standards. Further descriptions of the field testing procedures are enclosed in Appendix A of this report. The boring location plan (Figure 1), subsurface profiles (Figures 2, 3 & 4) and soil test boring records are attached to Appendix B. Our previous subsurface investigation report (Project No. 06-1899) is included in Appendix C.

SITE CONDITIONS

As noted previously, the planned locations of the clearwell improvements structures are in an undeveloped wooded area in the northwest corner of the PWPF site, immediately west of an existing 2.0-MG clearwell. The Phase 2 clearwell and electrical building are partially located within an old undocumented fill area. The remainder of the site appears to be undisturbed with no existing fill. Site topography varies from nearly level to moderately sloping up generally to the north. Based on the provided *Master Plan Option 2* and available GIS topography, indicated total relief in the development area is in excess of 30 feet, varying from a low elevation of about 1150 feet along the south edge to a high elevation over 1180 feet in the northwest corner. There appears to be errors in the topography shown on *Master Plan Option 2*, as the indicated elevations of the boring locations are somewhat different from the surveyed elevations in some cases.

AREA AND SITE GEOLOGY

Geologically, the Cumming PWPF site is located in the Upland Georgia Subsection of the Piedmont Physiographic Province of Georgia. The location appears to be in an area along the convergence of the Central Uplands District to the northwest and the Gainesville Ridges District to the southeast. Both of these districts are characterized generally by low linear ridges; however, linearity of the ridges in the southwestern part of the Central Uplands District is not so prominent. Maximum elevations of the ridges occur in the northeastern areas of the districts and top out at 1300 to 1500 feet in the Central Uplands and 1500 to 1600 feet in the Gainesville Ridges. Elevations in the southwestern parts decrease to around 1100 and 700 feet, respectively.

The southern boundary of the Gainesville Ridges District is along a relatively continuous ridge that forms the drainage divide between streams flowing to the southwest and those flowing to the south. The boundary is generally along the Brevard fault zone, which extends across Georgia from northeast of Montgomery, Alabama to near Mount Airy, North Carolina.

The Piedmont Physiographic Province is an area bounded by the Ridge and Valley, and Blue Ridge provinces on the north and the Coastal Plain on the south. The Upland Georgia Subsection of the Piedmont consists of rocks northwest of the Brevard fault zone. The Piedmont is underlain by ancient igneous and metamorphic rocks of Paleozoic age (230 to 600 million years). The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. The rocks are crystalline in structure, having been cooled from a remolded molten mass, and are composed primarily of quartz, feldspar, mica and a number of dark minerals such as hornblende. Their chemical decomposition occurs first as a breakdown along the boundaries of the individual mineral crystals.

Review of the *Geology of the Greater Atlanta Region*, McConnell and Abrams, 1984, shows the PWPF site is underlain by metamorphic rocks of the Powers Ferry Formation (pfu), which includes undifferentiated biotite-quartz-plagioclase gneiss (metagraywacke), mica schist, and amphibolite. Gneiss is a foliated, biotite, quartz feldspar rock formed by regional metamorphism. Schist is a strongly foliated crystalline rock formed by dynamic metamorphism. It has well developed parallelism or banding of more than 50 percent of the minerals present in the rock, particularly mica and hornblende. Schist is similar to gneiss but with higher amounts of mica and hornblende. Amphibolite is a dark-colored, non-foliated crystalline rock formed through recrystallization, under conditions of high viscosity and direct pressure. It is composed of mainly amphibole and plagioclase minerals with little or no quartz. As the quartz content increases, amphibolite grades into a hornblende-plagioclase gneiss.

All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical weathering of the underlying rocks. Due to their crystalline structure, chemical weathering occurs first as decomposition along the boundaries of individual mineral crystals and slightly weathered rock materials are formed having the appearance of very dense sands. Sand crystals in the slightly weathered rock are in the same positions originally occupied in the parent rock. Further chemical weathering results in disintegration of individual crystals and the formation, typically, of micaceous silty sand or micaceous sandy silt in which the original crystalline structure is obscured but banding of the parent rock is apparent. Due to more advanced weathering, the silty sand or sandy silt materials are changed into red or reddish brown silty clay or clayey silt and both the original crystalline structure, and the layered rock appearance are lost. The red soil coloration is produced primarily by oxidation of iron in the feldspars, micas and dark minerals.

Normally, weathering of the rock is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. A transition from clay to silt to silty sand to partially weathered rock (PWR) to hard rock is typical; however, this order of weathering is not always followed and it is not uncommon to find seams or areas of PWR or relatively unaltered rock within the soil mantle or weathered rock layers within the underlying parent rock mass. The naturally developed soil profile may also be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away or covered by washed-in alluvial soils or manmade fill, or both.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions; however, localized groundwater flow roughly follows the flow of surface water. Although hydraulically connected to the water table aquifer, groundwater at depth in the rock is found in water-bearing fractures. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface.

SUBSURFACE CONDITIONS

Phase 2 Clearwell Improvements

At the planned clearwell and electrical building locations, previous 2006 borings B-1, B-2, and B-4 through B-7 and all current borings, except B-9, encountered an upper layer of fill overlying residual soils. A deeper layer of partially weathered rock and then auger refusal materials were encountered below the fill in most of these borings. Fill is any material that has been placed by man. Residual is a term used to define soils formed in-place by the chemical weathering process of the underlying rocks. Residual material that can be penetrated by power augers and exhibits standard penetration resistances of at least 100 blows per foot is termed partially weathered rock. Refusal is a designation applied to any condition which cannot be further penetrated by the soil drilling process and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Fill, At the boring locations noted above, fill was encountered from near the ground surface to depths ranging approximately from a minimum of 3 or 4 feet in current boring B-8 to a maximum of 33 feet in current boring B-7. The fill was sampled generally as silty sand (SM) and sandy silt (ML) with some well graded sand (SW), clayey silt (MH) and clay (CL-CH) layers. The split-spoon samples also typically contained rock fragments. Scattered throughout the fill are variable quantities of rocks, wood and other organic matter at random depths and locations. Relative density or consistency of the fill soils varies appreciably as indicated by standard penetration resistances ranging from a minimum of 2 blows per foot (bpf) to a maximum of 53 bpf. The higher penetration values appear to be due to rocks or other hard objects encountered in the fill.

Residual Soils/Partially Weathered Rock. Residual soils and then partially weathered rock were typically found below the fill and below a thin topsoil layer at the location of boring B-9. Current borings B-15 and B-17 were terminated in the residuum at a depth of 40 feet. Also, previous borings B-5 and B-7 were terminated in residual soils at a depth of 50 feet and previous borings B-4 and B-6 encountered residual soils to auger refusal at depths of 53 and 63 feet bgs, respectively. Residual soils extended to the top of partially weathered rock at depths varying from 29 to 53 or 54 feet in the remaining borings. The residual soils were classified as either sandy silt (ML) or silty sand (SM). A single layer of sandy clay (CL) was also identified to a depth of 3 feet in boring B-9. Standard penetration resistances in the residual soils ranged from a minimum of 2 to a maximum of 38 bpf in this area. Penetration values indicate generally firm to very stiff consistency of the silt and clay and medium dense relative density of the sand.

All current and previous borings, except those noted above that were terminated in residual soils, encountered 2 to 16 feet of continuous partially weathered rock to auger refusal or boring termination depths. The partially weathered rock materials were sampled as either very dense silty sand (SM) or very hard sandy silt (ML) with some rock fragments.

Auger Refusal Conditions. Hollow stem auger refusal conditions were encountered at depths varying from 36 to 67 feet in all borings, except those noted above that were terminated in the residuum at depths of 40 and 50 feet. Rock core drilling or other exploration methods are required

to determine the nature and continuity of refusal material; however, refusal conditions at the boring locations appear to be the upper surface of bedrock.

Groundwater. Stabilized groundwater levels were measured in the current exploration borings at depths varying approximately from 20 or 21 to 34 feet below the existing ground surface. In general, the groundwater level measurements correlate to a water table elevation between 1137 and 1142 feet and northwest to southeast flow direction. Groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than reported during this study.

Phase 2B High Service Pump Station & Future Phase 4 Clearwell

Subsurface conditions within the proposed high service pump station & future clearwell area were investigated by current soil test borings B-11 through B-14 and B-1 through B-5, respectively. Conditions encountered in these borings consist of undisturbed residual soils overlying partially weathered rock and then auger refusal conditions below a thin layer of topsoil at the ground surface. Groundwater was encountered in three of these borings at the time of the field investigation.

Residual Soils/Partially Weathered Rock. Residual soils were encountered from near the ground surface to the top of partially weathered rock varying from 13 or 14 feet to 30 feet at all boring locations in this area. As described in the previous Phase 2 section, the residual soils are classified mainly as sandy silt (ML) and silty sand (SM). Layers of sandy clay (CL) were also initially encountered in most of the borings to depths varying from 3 feet to 8 or 9 feet below ground. Penetration values in these soils varied from a minimum of 5 to a maximum of 53 bpf, but most ranged between 8 or 9 blows and 30 blows, again indicating firm to very stiff consistency for silt and clay and medium dense relative density for the sand.

A continuous partially weathered rock stratum, varying in thickness from 2 to 17 feet approximately, was encountered in the borings from below the residual soils to hollow-stem auger refusal depths. Partially weathered rock within the pump station and future clearwell locations was sampled entirely as very dense silty sand (SM) with frequent rock fragments.

Auger Refusal Conditions. In this area, hollow stem auger refusal conditions were encountered at all boring locations at depths varying from 16 to 45 feet below ground. As noted previously, the refusal conditions appear to be the upper surface of bedrock.

Groundwater. Stabilized groundwater levels were measured at depths of 33 to 34 feet in borings B-1 and B-2 and at 16.5 feet in B-13. The groundwater level measurements correlate to water table elevations ranging approximately from 1148 or 1149 at borings B-1 and B-2 to 1137 or 1138 feet at the location of boring B-13. The groundwater data in this area also indicates a northwest to southeast flow direction.

PROJECT INFORMATION

Our understanding of this project is based on our previous discussions and the information in the provided *Geotechnical Loading Information, Revised Concept Site Plan*, dated 10/15/25. The project includes two 160-foot diameter, 6.0-million gallon (MG) clearwells (Phase 2 and future Phase 4), a high service pump station and an electrical building. Phase 2 and Phase 2B construction includes one clearwell, the electrical building, and the high service pump station. The second clearwell will be added in the future Phase 4 construction.

The planned clearwell improvement structures will be constructed in an undeveloped wooded area in the northwest corner of the existing PWPF immediately west of an existing 2.0-MG clearwell. The clearwell structures will be 160-foot diameter 40-foot tall, prestressed concrete ground storage tanks. A bottom elevation at 1160 feet is proposed for the Phase 2 clearwell. No bottom elevation for the Phase 4 clearwell was provided but we assume the bottom elevation will also be 1160 feet.. Approximate excavations varying from 2 to 17 feet for the Phase 2 clearwell and 9 to 24 feet for Phase 4 are estimated to achieve the planned bottom elevation.

The typical foundation system for prestressed concrete, ground storage tanks, based on our previous experience and information provided by *ASI 372R* and *AWWA D110*, consists of a thin (6-inch minimum) reinforced monolithic, turndown concrete slab overlying a 6-inch thick crushed stone base. A turndown edge footing is usually included along the entire circumference of the slab to support the exterior perimeter tank wall. We understand that prestressed concrete storage tanks, such as planned for the clearwells in this project, can tolerate up to about 6 inches of uniform total settlement; however, angular distortion of the membrane floor, expressed in terms of the slope of the settlement profile, is typically the controlling factor. The ACI document, *Design and Construction of Prestressed Concrete Structures* (ACI 372R) recommends a maximum limit of ¼-inch differential settlement in a 10-foot distance. The clearwell information provided notes a total uniform contact pressure of 3,000 pounds per square foot underneath the circular base foundation slab and a perimeter wall load of 10,000 pounds per linear foot. The continuous turndown perimeter wall footing is typically designed using a contact pressure equivalent to the circular base foundation loading.

We understand the proposed electrical and pump station buildings will be conventional CMU type construction. A finished floor elevation of 1158 feet is planned for both structures. The existing topography indicates that cuts of 2 to 10 feet for the electrical building and about 8 feet of fill and 17 feet of cut for the high service pump station will be required to achieve the finished floor elevation. Foundation loading conditions of 2.2 kips per linear foot (klf) for the electrical building and 3.5 klf for the pump station continuous load bearing exterior perimeter walls and 250 psf for both structure slabs were provided. A maximum interior wall load of 6.0 klf was also noted for the pump station.

DESIGN & CONSTRUCTION RECOMMENDATIONS

Seismic Site Classification

Site classification for seismic design of the proposed clearwell improvements project was determined in accordance with ASCE/SEI 7-22. Subsurface conditions to a depth of 100 feet were not investigated at the site and site-specific determination of the shear wave velocity profile to a depth of 100 feet below the ground surface was not performed to confirm the seismic site classification. Where site-specific data (measured shear wave velocities or other geotechnical data that can be used to estimate shear wave velocity) are not known in sufficient detail to determine the site class, the most critical site conditions of Site Class C, Site Class CD and Site Class D shall be used unless the geotechnical data determine that Site Class DE, E, or F soils are present at the site. Based on the limited available boring data and our previous experience with similar subsurface conditions, Site Class D (Medium dense sand or stiff clay), per the ASCE/SEI 7-22 definitions provided in Table 20.2-1, is recommended for design of the PWPF clearwell improvement structures.

Site Preparation

Initially, the site needs to be cleared of trees and all weeds, vines, grass and topsoil stripped from the ground surface in the proposed structure locations. The topsoil and other stripped materials should either be wasted from the site or stockpiled for later top dressing of disturbed areas prior to permanent seeding and or stabilization. On completion of the clearing and stripping operations, the construction area should be carefully inspected by the project geotechnical engineer. At that time, the engineer should observe areas near finished grade that are intended to support the structures or new structural fill and observe proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Inspection and proofrolling of the structure subgrade areas is to confirm the subgrades have been properly prepared and to identify any soft, weak, or excessively wet soils that may be present. Depending on the weather and observed conditions, some stabilization measures and/or undercutting and replacement of weak or wet soils with structural fill and/or crushed stone may be required to provide adequate subgrade support conditions. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the geotechnical engineer.

Earthwork

All fill required to achieve site grades, backfill excavations around structures or replace undercut areas should be clean soil, free of organic matter and deleterious material. Material containing rocks or stones greater than 3 inches in diameter should not be used. Structural fill soils should also have a plasticity index (PI) typically less than 30 and a maximum dry density of at least 100 pcf as determined by the standard Proctor compaction test (ASTM D-698).

General site structural fill should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the standard Proctor maximum dry density. Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent standard Proctor. All fill material should be placed in horizontal lifts and adequately keyed into the existing subgrade.

Moisture control of the fill soils is essential in achieving specified densities and soil moisture contents within $\pm$3 percent of the optimum moisture content (OMC) should be maintained during placement and compaction. We recommend that the grading contractor have equipment on site during fill placement for both drying and wetting the soils to control moisture contents within the required range for compaction.

During fill placement, an adequate number of density tests should be performed by a soils technician working under the direction of the project geotechnical engineer to determine the degree of compaction and compliance with the project specifications. Tests should be performed for each 2-foot thick layer of compacted fill. Any areas that do not meet compaction requirements should be reworked to achieve compliance.

Foundation Support

Phase 2 Clearwell & Electrical Building. At these structure locations an upper layer of undocumented fill was initially encountered over a majority of the construction area. The fill is undocumented in terms of there being no previous records on the nature of the fill materials and compaction during placement. The soil test boring data show the fill is an inconsistent mixture of soil and rocks or boulders with wood debris and other unidentified organic matter. The wood debris was identified in the split-spoon samples as wood fragments and relatively intact, large pieces of apparent tree limbs.

The consistency or relative density of the existing fill soils encountered in the borings is erratic with significant zones of soil exhibiting low standard penetration values generally ranging from 4 to 9 bpf. The low penetration values indicate these soils were likely placed with little or no compaction effort, resulting in relatively weak and compressible support conditions. In our opinion, higher penetration values in the fill are likely exaggerated due to encountering rocks and other obstructions buried within the fill soil matrix. Due to inadequate soil compaction, the fill is susceptible to excessive settlement under increased loading conditions. Long term settlement is also likely from natural decomposition of wood and other organic matter buried in the fill. Settlement will likely be aggravated if the fill contains any voids, which usually occur within uncontrolled rocky/boulder fills.

The existing undocumented fill conditions in this area makes it very difficult and impractical to evaluate soil bearing capacity and settlement. However, our previous experience with similar conditions shows that excessive differential settlement of the clearwell and electrical building will likely occur. Due to excessive settlement and likely other issues with foundation support in these

difficult subsurface conditions, we recommend the clearwell and electrical building be moved to locations where support can be provided in undisturbed residual soil conditions. If the clearwell can be moved approximately 100 feet north of the current proposed location, it appears adequate foundation support can be achieved in undisturbed residual soil conditions with soil bearing capacities of at least 4 ksf. If the structures cannot be relocated, we recommend stone columns or aggregate piers, rigid inclusions, or other ground improvement measures be implemented for foundation support.

Stone columns or aggregate piers are columns of compacted crushed stone installed in groups to increase bearing capacity, mitigate settlement and allow the use of conventional shallow foundations. Also referred to as rammed or vibro column/piers that are constructed by compacting lifts of granular material (typically No. 57 crushed stone) into the ground, laterally displace weak soil and create individual columns. At this site, either a hollow mandrel tamper or a high-frequency vibratory probe should be used for placing and compacting of the crushed stone in the columns to prevent possible caving. This installation method requires the crushed stone be tremied to the tip of the tamper or probe at the bottom of the column and then the aggregate column is compacted as the probe is withdrawn to the ground surface. Once installation is complete, foundations can be constructed directly over the aggregate columns and no structural connection is required. Generally, a shallow foundation allowable soil bearing capacity on the order 5 to 6 ksf can be developed for aggregate column support.

Improvement of the subsurface conditions with rigid inclusions consists of installing unreinforced, cement grouted columns similar to piles into the ground to control settlement. Rigid inclusions will also allow the use of higher bearing capacities than those available before improvement for shallow foundation support. Rigid inclusions are installed by laterally displacing the soil using generally vibrating probes or reverse flight rotating augers. Once the probe or auger is advanced to the design bearing stratum, the tools are withdrawn, and grout is pumped into the bottom of the void during withdrawal to fill each column. The columns are not connected directly to the foundation, as piles would be, but they are designed to take advantage of the surrounding soil resistance and act together with the soils to provide the ground improvement. A load transfer platform (LTP), consisting of a 12 to 18-inch thick layer of compacted granular fill is usually required on top of the rigid inclusions as a bridge between the foundation and the rigid inclusions. The LTP will distribute the foundation loads to the rigid columns and surrounding soils and reduce stress concentrations from the columns on the foundation.

Many factors are considered in determining feasible ground improvement measures and designs are best carried out by specialized geotechnical contractors utilizing their previous experience and adapting their specialized products, equipment and construction methods to the site-specific conditions. A company with knowledge and experience in the design and construction of aggregate columns and other ground improvement measures can also provide engineering support in the design stages of the project and help determine the most feasible and economical foundation solution. We recommend that specialty geotechnical contractors such as Keller, Geopier, Menard USA, Nicholson Construction or others be consulted during the planning and design phase of the project to help in determining the most feasible and cost-effective type of ground improvement measure for the clearwell and electrical building structures in the undocumented fill area. Proposal

or bid requests for design and installation of the proposed ground improvement measures should include a performance specification assuring the proposed foundation support system complies with the load resistance capacity and settlement tolerance provisions for the structures.

Phase 2B High Service Pump Station & Future Phase 4 Clearwell. The boring data for these structures shows the undisturbed residual soil conditions should provide adequate long-term foundation support for the range of structural loads anticipated. At the anticipated foundation bearing elevations, the available foundation design soil bearing capacity in undisturbed residual soils is at least 4 ksf. We understand the actual contact pressure beneath the circular clearwell bottom is 3 ksf. Since the southeast portion of the high service pump station will be supported in new structural fill, allowable soil bearing capacity for foundation design is limited to 3 ksf in the fill soil area.

Subject to the site preparation and inspection recommendations in this report; the Phase 4 clearwell may be designed using the conventional monolithic slab-on-grade foundation system. The foundation should be of sufficient thickness and have adequate reinforcement to prevent cracking between the flat and thickened portions of the slab. The thickened portion of the foundation, underneath the perimeter wall of the tank, should bear at a depth of at least 12 inches below finish grade, which is the maximum frost penetration depth in the Atlanta area. A minimum of 6 inches of compacted crushed stone or sand is recommended to be installed on the foundation subgrade prior to concrete placement to provide uniform support conditions. Angular distortion of the standard tank foundation slab, expressed in terms of the slope of the settlement profile between the center and edge of the tank, is anticipated to be less than the tolerable limit of ¼-inch differential settlement in a 10-foot distance.

The high service pump station may be designed for conventional shallow slab-on-grade foundations or continuous footings bearing in existing undisturbed residual soils or new structural fill. Available bearing capacities in the residuum vary from 4 ksf in the residual soils to 10 ksf or more in partially weathered rock anticipated in the northwest corner of the structure. As noted above, foundations should be designed for a maximum allowable soil bearing capacity of 3 ksf in new structural fill required in the southeast portion of the pump station. A minimum width of 18 inches for continuous wall footings should be used for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report. Building grade slabs should be jointed around any individual equipment foundations and along footing-supported walls to minimize cracking due to possible differential movements. As an alternative to flat slab-on-grade floors and conventional spread footings, monolithic turned-down slab-on-grade floors be used. Turned-down slabs should be thickened underneath heavy equipment and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

Foundation Inspection

We recommend that all foundation excavations be evaluated at the time of construction by the project geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressure. Some stabilization measures and/or undercutting and replacement of weak or wet soils with crushed stone may be required in order to provide adequate foundation support. The extent of any stabilization measures or undercutting required should be determined at the time of construction by the inspecting geotechnical engineer.

Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, or other deleterious materials prior to placement of concrete. In addition, foundation concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to construction of the footings or foundation slabs. We recommend that foundation excavations be concreted as soon as practical after they are excavated and storm water or runoff should be prevented from ponding on or infiltrating the bearing surface. If it is necessary to leave foundation excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

Slope Stability

Our exploration did not include analysis of slope stability for any temporary or permanent condition. However, based on conditions at this site and OSHA requirements, we recommend that simple temporary slopes for properly dewatered excavations or excavations above the water table not exceed 1.5(H):1.0(V). Exposed slope faces should be protected from precipitation with an impermeable cover until the work is completed. Also, slope conditions should be inspected daily for any signs of instability such as tension cracks, bulging, or deterioration of the embankment soils.

Permanent slopes no steeper than 2.0(H):1.0(V) are recommended for construction in undisturbed residual soils above the water table or structural fill placed in accordance with our recommendations. Minimum setback distances from the top of slope of 10 feet for structures and 5 feet for pavements is also recommended. Appropriate groundcover provisions should be made for protection of permanent slopes from erosion.

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Development of the full active earth pressure case requires a magnitude of horizontal wall movement that often cannot be tolerated or cannot occur due to the rigidity of the

wall or other design restrictions such as the impact on adjacent structures. In such cases, walls are often designed for either the at-rest condition or a condition intermediate of the active and at-rest conditions, depending on the amount of permissible wall movement. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition.

A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Passive conditions are typically assumed for portions of walls buried beneath the wall toe elevation. Since significant wall movements are required to develop passive resistance, the total calculated passive pressure should be reduced by at least 50 percent for design purposes.

Based on the boring information and our previous experience with similar soils, we recommend effective soil strength parameters of 0 psf for cohesion (c) and angles of internal friction (ϕ) of 25 and 28 degrees be used in determining lateral earth pressures for design of required temporary excavation shoring and the below grade structure walls. The angle of internal friction value of 25 degrees applies to structural fill compacted to 95 percent standard Proctor or undisturbed residual soils with standard penetration resistances generally less than 10 bpf. The 28-degree friction angle value may be used in structural fill compacted to 98 percent standard Proctor or undisturbed residual soils with penetration values greater than 10 bpf. An in-situ moist soil unit weight of 120 pcf is also recommended for design calculations. If any excavations or walls extend below the water table, lateral earth pressures should be determined using the buoyant weight of the soil. Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Using ϕ-angles of 25 and 28 degrees results in the following earth pressure coefficients for design of the proposed lift station and grit structure below grade walls and any temporary shoring that may be required for installation:

Earth Pressure Conditions	**Coefficient**	
	25°	**28°**
Active (K_A)	0.41	0.36
At-Rest (K_O)	0.58	0.53
Passive (K_P)	2.46	2.80

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the surcharge load does not intersect the wall, the effect of the load on the wall may be neglected. Whenever this line intersects the wall, the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses. Foundation bearing levels may also be lowered to eliminate increased stresses on adjacent below grade structures or retaining walls.

QUALIFICATION OF RECOMMENDATIONS

This report has been prepared for the exclusive use of the City of Cumming for design and construction of the proposed PWPF clearwell improvements. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with the skill and care ordinarily provided by professional geotechnical engineering practice in the Piedmont geologic setting under the same or similar circumstances for projects of this type and at the time of these services. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions. Allowable soil bearing capacity was estimated from previous correlations of standard penetration resistances and bearing capacities of comparable soils. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

We note that regardless of the thoroughness of a geotechnical exploration there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the conditions to address any issues. Should the project plans change substantially from those outlined in this report, we also request the opportunity to review our recommendations in light of any changes.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D 1586. Borings are usually advanced either by mechanically twisting continuous steel hollow-stem auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

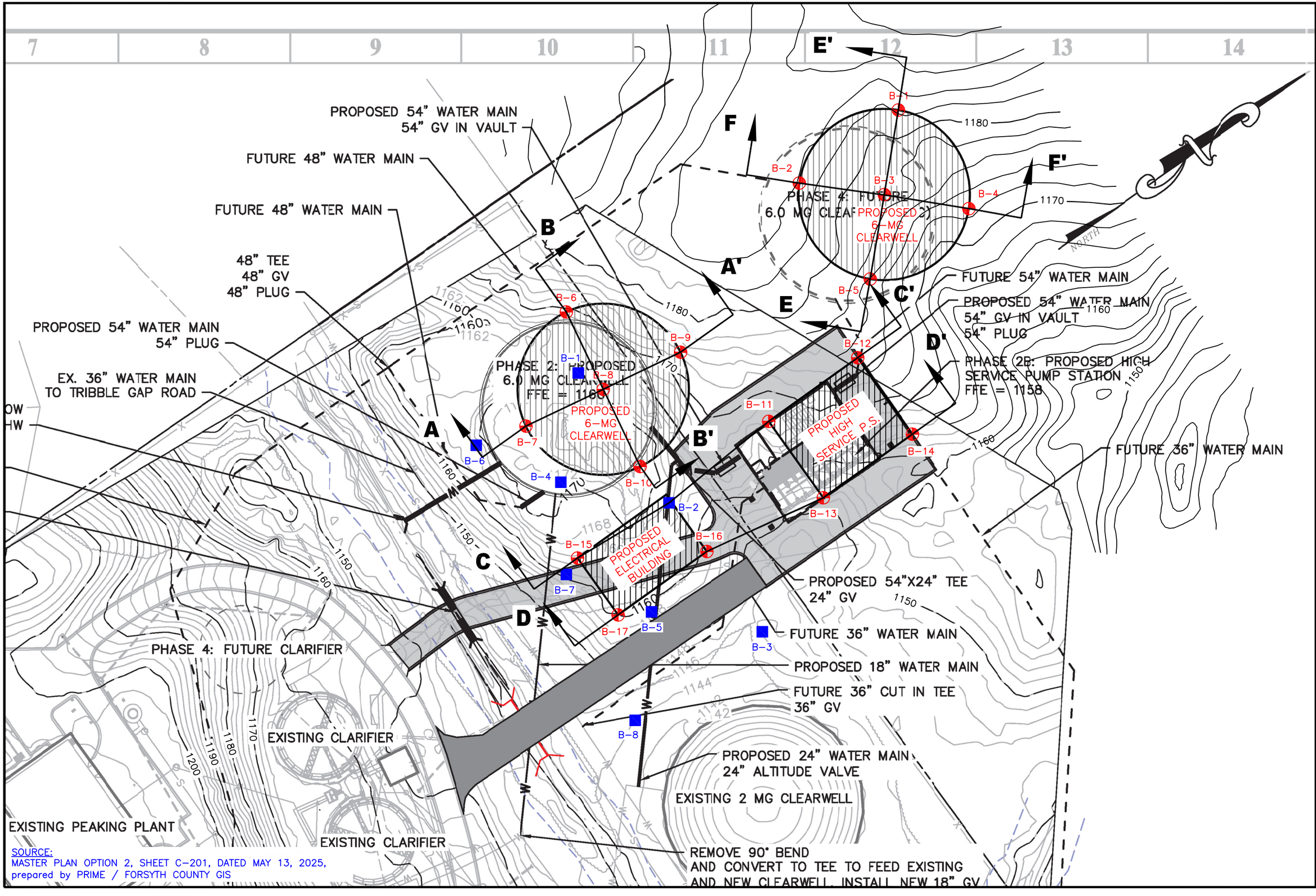
Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D 2487). In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

APPENDIX B

FIGURE 1 – SITE LOCATION PLAN
FIGURE 2 – SUBSURFACE PROFILES
FIGURE 3 – SUBSURFACE PROFILES
FIGURE 4 – SUBSURFACE PROFILES
KEY TO SYMBOLS AND CLASSIFICATIONS
SOIL TEST BORING LOGS (17)



SOURCE:
MASTER PLAN OPTION 2, SHEET C-201, DATED MAY 13, 2025,
prepared by PRIME / FORSYTH COUNTY GIS

BORING LOCATION PLAN

FIGURE: 1

PREPARED BY: ARC
DATE: 1/12/2026
REVIEWED BY: LDM
DATE: 1/12/2026

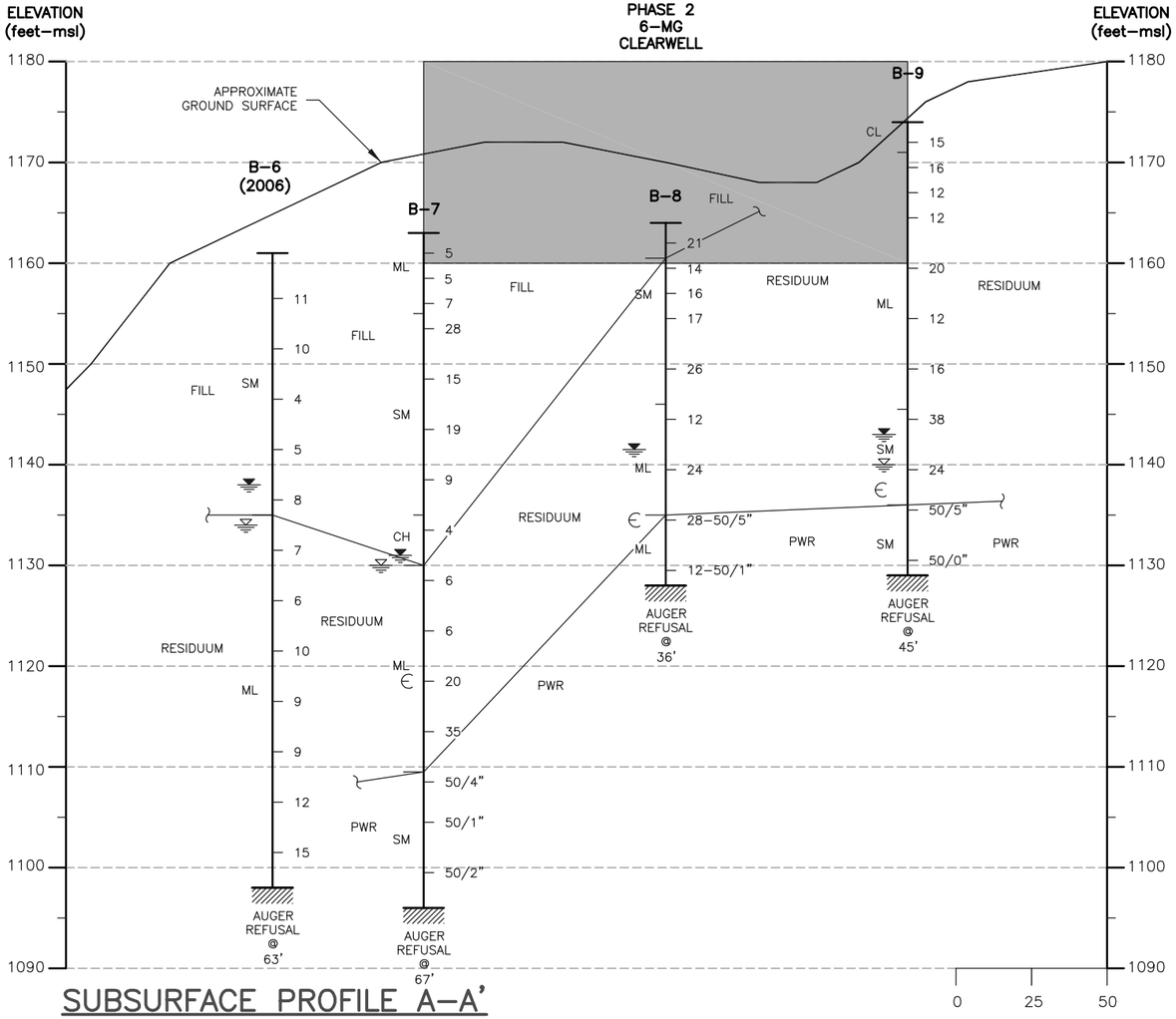
PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

GEOSYSTEMS ENGINEERING, INC.

REFFERENCE: C_PWPF P2.dwg

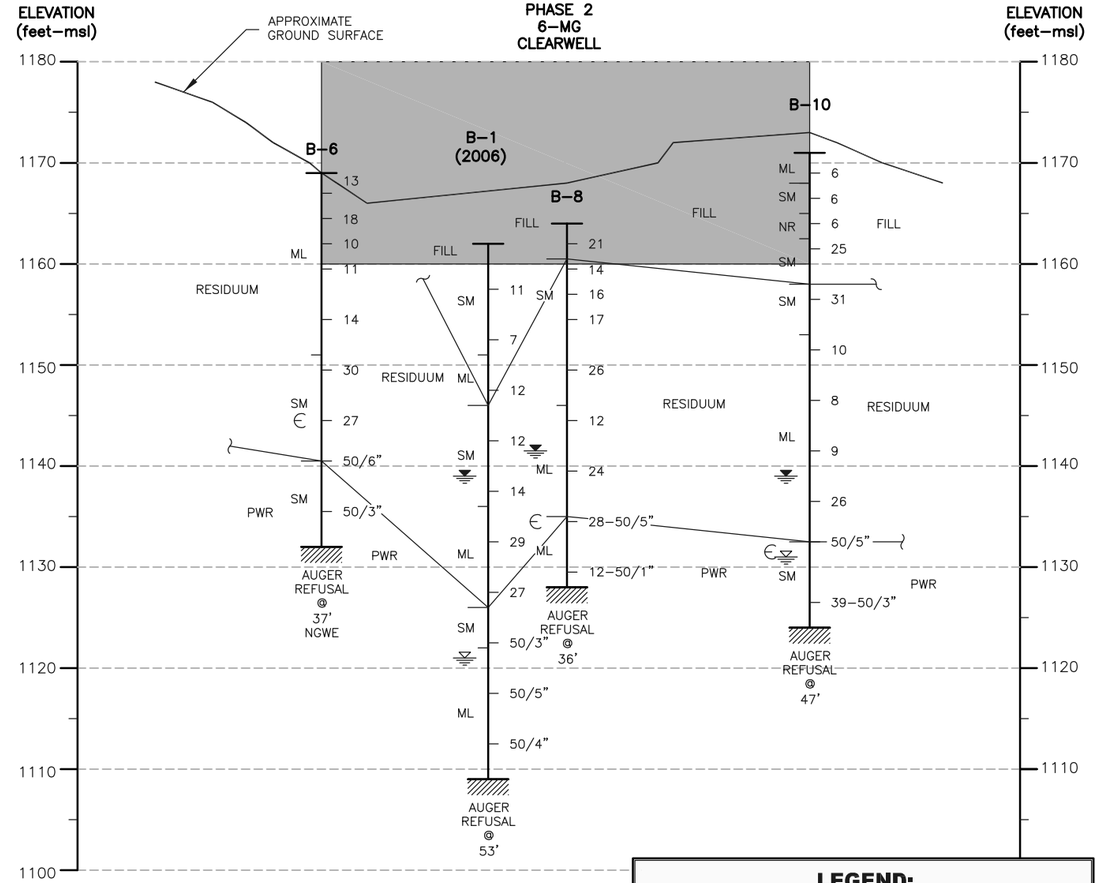
LEGEND
- SOIL TEST BORING (THIS INVESTIGATION)
- SOIL TEST BORING (2006 INVESTIGATION)

SCALE: 1" = 80' (APPROXIMATELY)



SUBSURFACE PROFILE A–A'

SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)

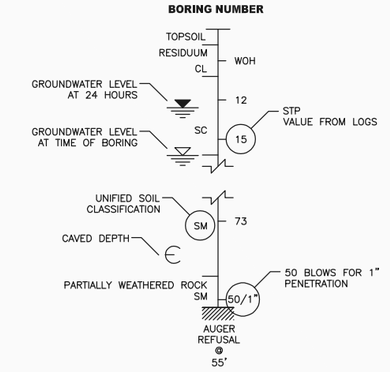


SUBSURFACE PROFILE B–B'

SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)

LEGEND:
TYPICAL SOIL TEST BORING PROFILE

NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

OH – HIGH PLASTICITY ORGANICS
ML – LOW PLASTICITY SILT
SM – SILTY SAND
SP – POORLY GRADED SAND
SW – WELL GRADED SAND
CL – LOW PLASTICITY CLAY
CH – HIGH PLASTICITY CLAY

ADDITIONAL ABBREVIATIONS

SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR – NO RECOVERY
PWR – PARTIALLY WEATHERED ROCK
NGWE– NO GROUNDWATER ENCOUNTERED

NOTES:

1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

SOURCE:
MASTER PLAN OPTION 2, SHEET C–201, DATED MAY 13, 2025, prepared by PRIME / FORSYTH COUNTY GIS

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

FIGURE: 2

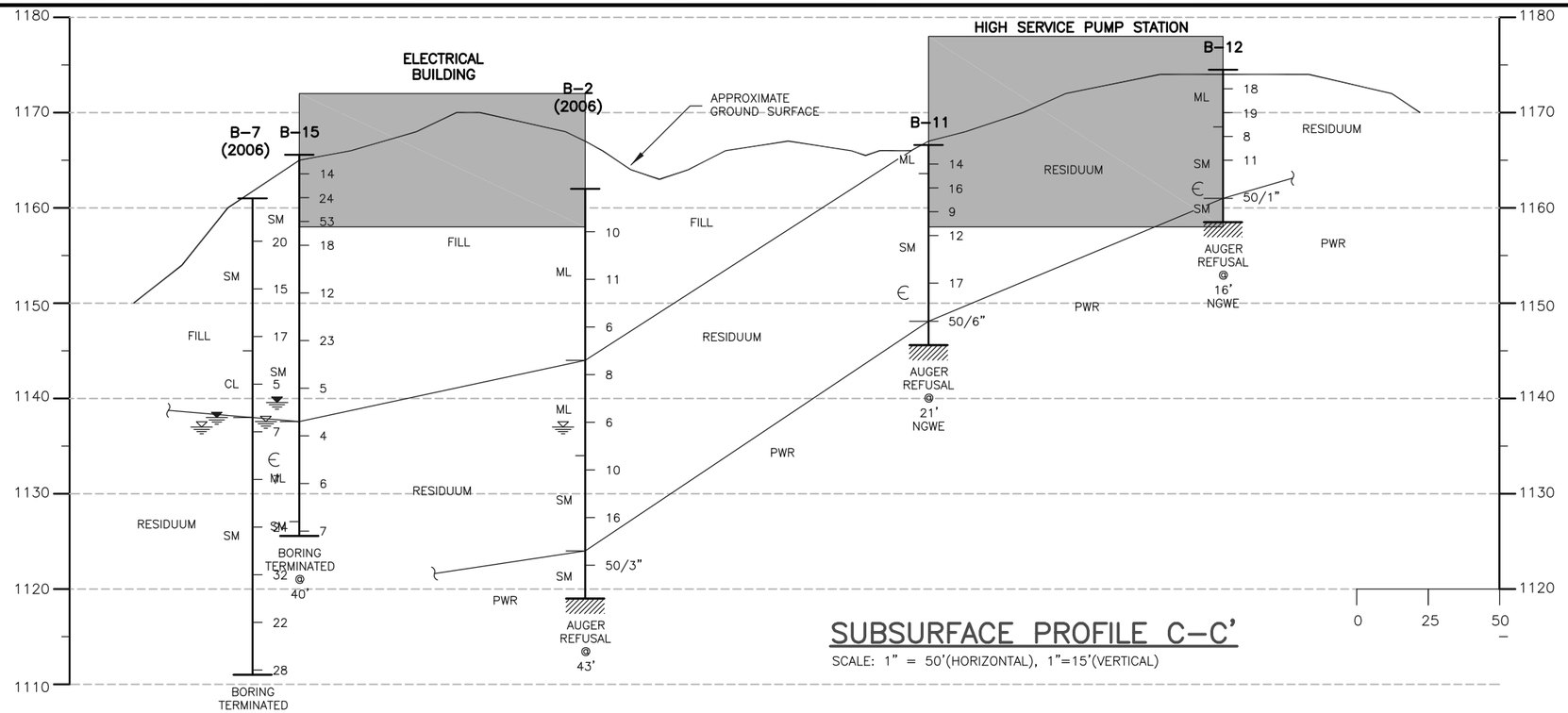
PREPARED BY: ARC
DATE: 1/12/2026
REVIEWED BY: LDM
DATE: 1/12/2026

GEOSYSTEMS ENGINEERING, INC.

LEGEND

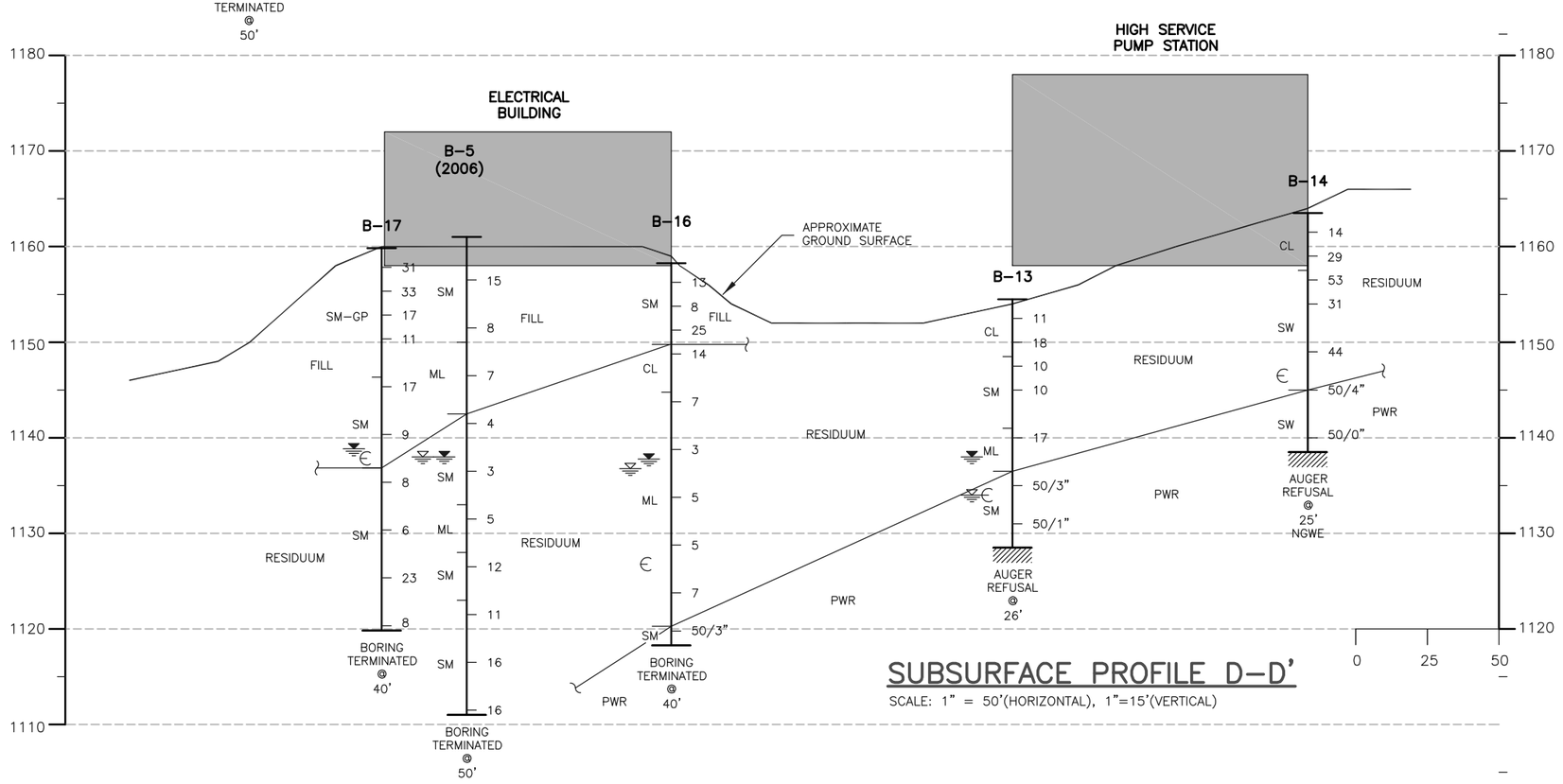
REFERENCE: BCW BLP.dwg

SCALE AS SHOWN (APPROXIMATE)



SUBSURFACE PROFILE C–C'

SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)



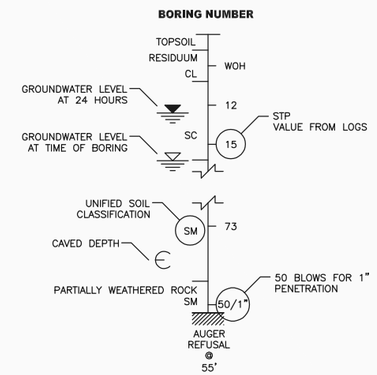
SUBSURFACE PROFILE D–D'

SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)

NOTES:

1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

- OH – HIGH PLASTICITY ORGANICS
- ML – LOW PLASTICITY SILT
- SM – SILTY SAND
- SP – POORLY GRADED SAND
- SW – WELL GRADED SAND
- CL – LOW PLASTICITY CLAY
- CH – HIGH PLASTICITY CLAY

ADDITIONAL ABBREVIATIONS

- SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
- WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
- NR – NO RECOVERY
- PWR – PARTIALLY WEATHERED ROCK
- NGWE– NO GROUNDWATER ENCOUNTERED

SOURCE:
MASTER PLAN OPTION 2, SHEET C–201, DATED MAY 13, 2025, prepared by PRIME / FORSYTH COUNTY GIS

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

FIGURE: 3

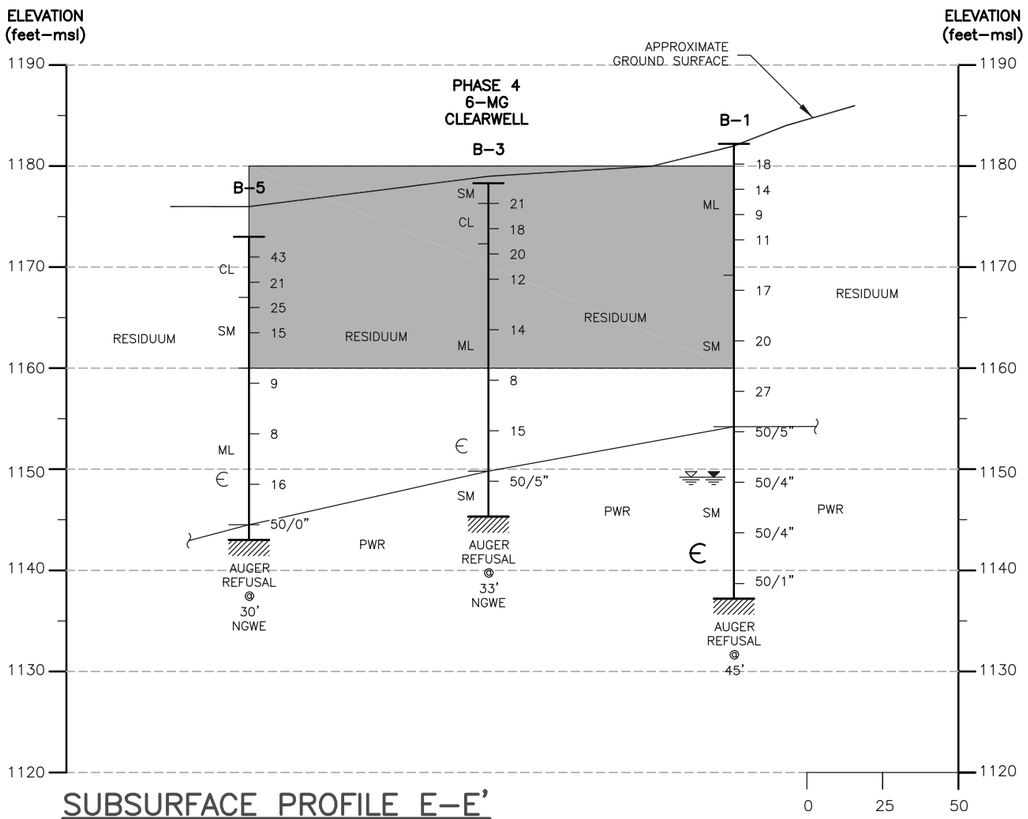
PREPARED BY: ARC
DATE: 1/12/2026
REVIEWED BY: LDM
DATE: 1/12/2026

GEOSYSTEMS ENGINEERING, INC.

LEGEND

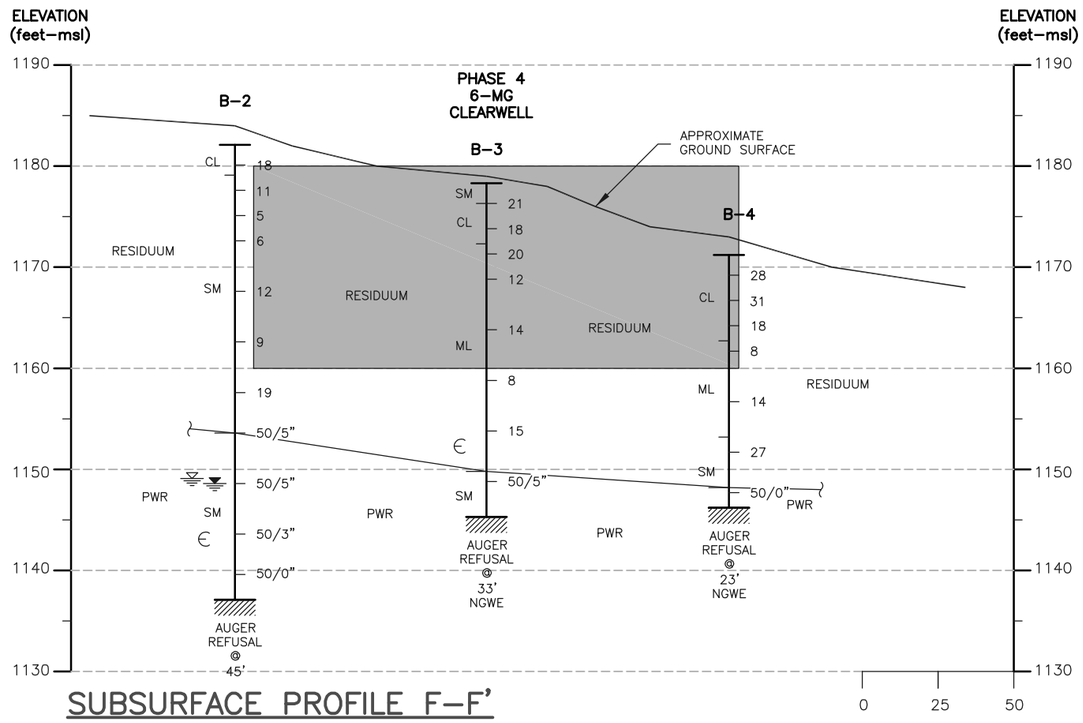
REFERENCE: BCW BLP.dwg

SCALE AS SHOWN (APPROXIMATE)



SUBSURFACE PROFILE E–E'

SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)



SUBSURFACE PROFILE F–F'

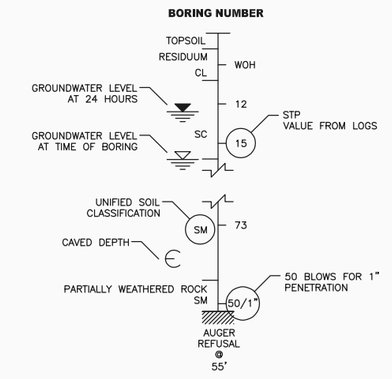
SCALE: 1" = 50'(HORIZONTAL), 1"=15'(VERTICAL)

NOTES:

1. Approximate ground surface is plotted from the provided Master Plan Option 2 and available Forsyth County GIS data.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

SOURCE:
MASTER PLAN OPTION 2, SHEET C–201, DATED MAY 13, 2025, prepared by PRIME / FORSYTH COUNTY GIS

LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

OH – HIGH PLASTICITY ORGANICS
ML – LOW PLASTICITY SILT
SM – SILTY SAND
SP – POORLY GRADED SAND
SW – WELL GRADED SAND
CL – LOW PLASTICITY CLAY
CH – HIGH PLASTICTY CLAY

ADDITIONAL ABBREVIATIONS

SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR – NO RECOVERY
PWR – PARTIALLY WEATHERED ROCK
NGWE– NO GROUNDWATER ENCOUNTERED

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE II CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

FIGURE: 4

PREPARED BY: ARC
DATE: 1/12/2026
REVIEWED BY: LDM
DATE: 1/12/2026

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

LEGEND

SCALE AS SHOWN (APPROXIMATE)

KEYS TO SYMBOLS AND CLASSIFICATIONS

SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS	FILL TOPSOIL PAVEMENT	PARTIALLY WEATHERED ROCK ROCK (GENERAL) WATER ALLUVIUM
COARSE GRAINED SOIL - GRAVELS & SANDS (MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)	CLEAN SANDS & GRAVELS (< 5% FINES CONTENT)	SP: Poorly graded sands SW: Well graded sands GP: Poorly graded gravels GW: Well graded gravels
	SANDS & GRAVELS WITH HIGH FINES CONTENT (> 15% FINES CONTENT)	SM: Silty sands GM: Silty gravels SC: Clayey sands GC: Clayey gravels
FINE GRAINED SOIL - SILTS & CLAYS (MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)	SILTS	ML: Low plasticity inorganic silts MH: High plasticity inorganic silts
	CLAYS	CL: Low placticity inorganic clays CH: High plasticity inorganic clays
	ORGANIC SILTS & CLAYS	OL: Low plasticity organic silts and clays OH: High plasticity organic silts and clays

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE CONSISTENCY
SILTS AND CLAYS	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
	OVER 50	Very Hard

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-1

GEOLOGIST: *NA*	ELEVATION (feet): *1182*
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *45*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *33* 24HR (feet): *33*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33 feet about 2 hours after drilling. 3. Borehole caved to a depth of 40.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1182	
	RESIDUUM: Very stiff to stiff red brown fine to medium sandy SILT (ML), small rock fragments, slightly moist		18
5		1177	14
	Stiff red brown fine to medium sandy SILT (ML), slightly moist		9
10		1172	11
	Medium dense brown gray slightly micaceous fine to medium SAND (SM), moist		
15		1167	17
	Medium dense gray and white slightly micaceous fine to medium SAND (SM), moist		
20		1162	20
25		1157	27
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray slightly micaceous silty fine to medium SAND (SM), slightly moist		50/5"
30	Very dense dark gray silty fine to coarse SAND (SM), rock fragments, very moist to wet	1152	
			50/4"
35		1147	
			50/4"
40		1142	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-1

GEOLOGIST: *NA*	ELEVATION (feet): *1182*
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *45*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *33* ▼ 24HR (feet): *33*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33 feet about 2 hours after drilling. 3. Borehole caved to a depth of 40.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft) 2 3 4 5 6 10 20 30 40 60 80
		Very dense dark gray silty fine to coarse SAND (SM), rock fragments, very moist to wet		50/1"	
45		Auger Refusal at 45 feet	1137		

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-2

GEOLOGIST: *NA*	ELEVATION (feet): *1182*	NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33.5 feet about 4 hours after drilling. 3. Borehole caved to a depth of 39 feet.
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *45*	
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *33* 24HR (feet): *33.5*	
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		3" - Topsoil	1182	
		RESIDUUM: Very stiff red brown fine sandy CLAY (CL), slightly moist		18
		Stiff red brown fine to medium sandy SILT (ML) , slightly moist		11
5			1177	
		Firm to stiff brown fine to medium sandy SILT (ML), slightly moist		5
				6
10			1172	
				12
15			1167	
		Loose brown slightly micaceous silty fine to medium SAND (SM), very moist		9
20			1162	
		Medium dense gray brown silty fine to medium SAND (SM), slightly wet		19
25			1157	
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to medium SAND (SM), slightly moist		50/5"
30			1152	
				50/5"
35			1147	
		Very dense gray and white silty fine to medium SAND (SM), rock fragments, wet		50/3"
40			1142	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-2

GEOLOGIST: *NA*	ELEVATION (feet): *1182*
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *45*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *33* 24HR (feet): *33.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Groundwater level measured at 33.5 feet about 4 hours after drilling. 3. Borehole caved to a depth of 39 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft) 2 3 4 5 6 10 20 30 40 60 80
		Very dense gray and white silty fine to medium SAND (SM), rock fragments, wet		50/0"	
45		Auger Refusal at 45 feet	1137		

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

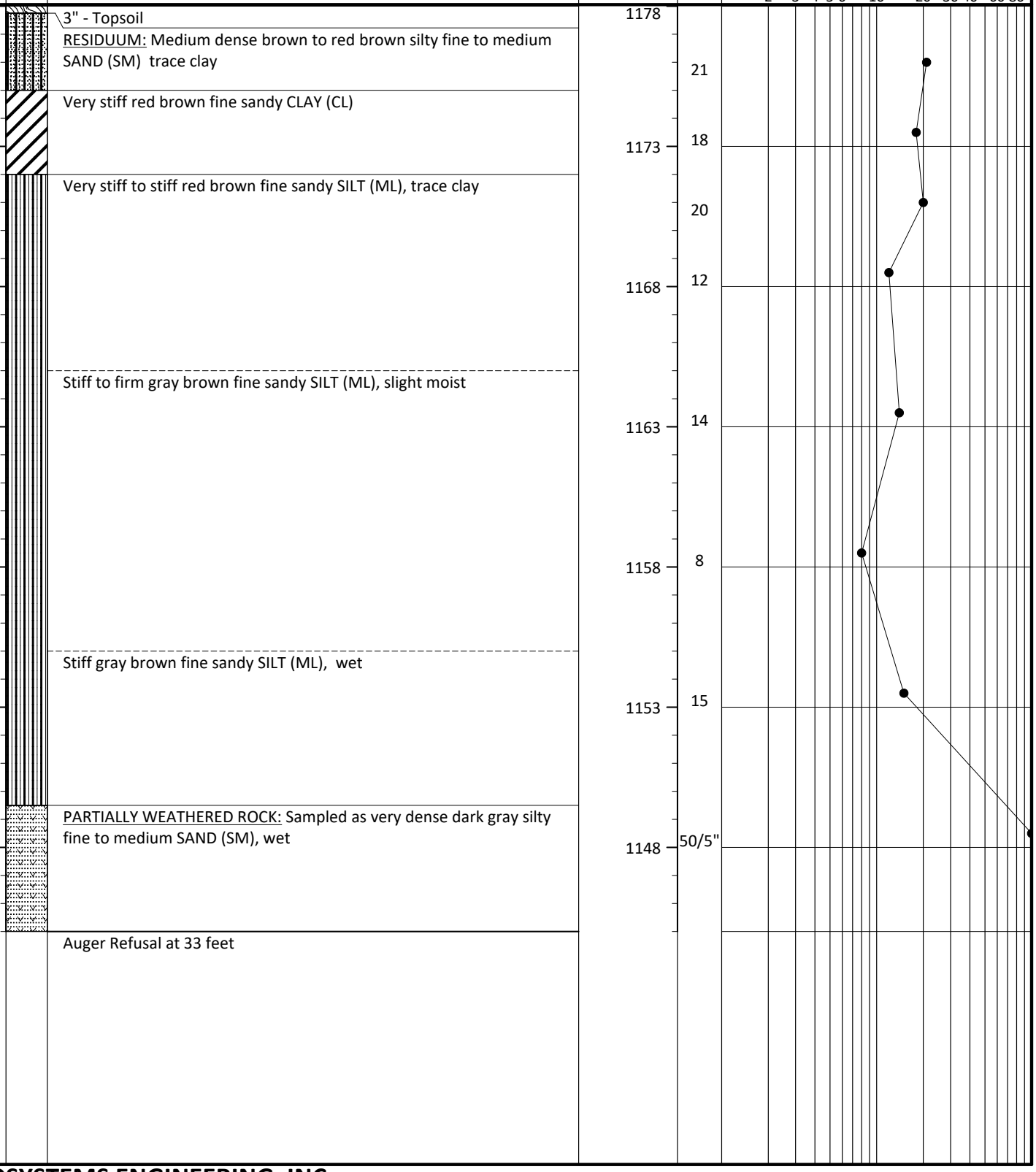
LOG OF BORING B-3

GEOLOGIST: *NA*	ELEVATION (feet): *1178*
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *33*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. Groundwater level was not measured after 24 hours (NGWE). 3. Borehole caved to a depth of 26 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1178	
	RESIDUUM: Medium dense brown to red brown silty fine to medium SAND (SM) trace clay		21
5	Very stiff red brown fine sandy CLAY (CL)	1173	18
	Very stiff to stiff red brown fine sandy SILT (ML), trace clay		20
10		1168	12
	Stiff to firm gray brown fine sandy SILT (ML), slight moist		
15		1163	14
20		1158	8
	Stiff gray brown fine sandy SILT (ML), wet		
25		1153	15
	PARTIALLY WEATHERED ROCK: Sampled as very dense dark gray silty fine to medium SAND (SM), wet		
30		1148	50/5"
	Auger Refusal at 33 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-4

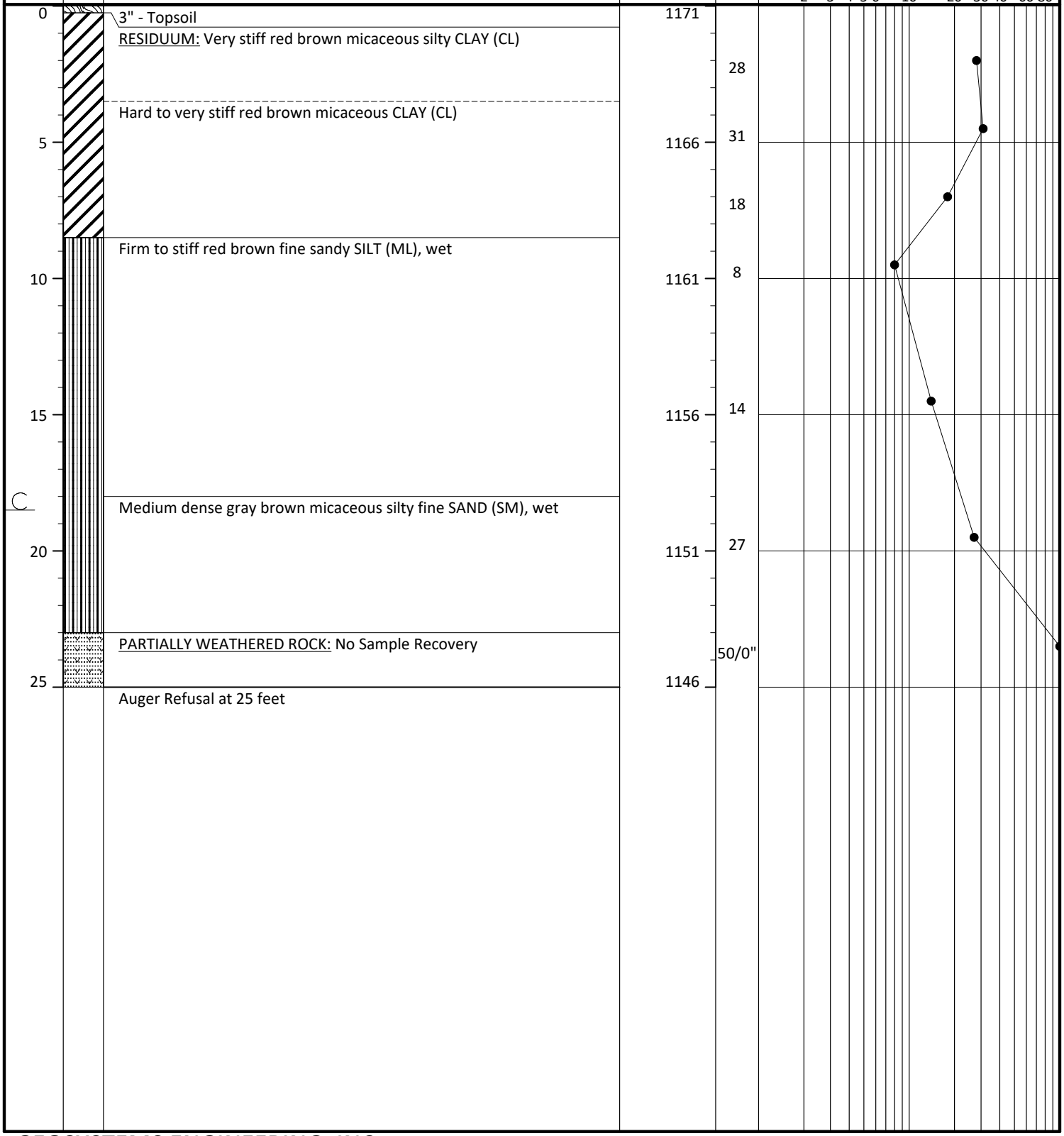
GEOLOGIST: *NA*	ELEVATION (feet): *1171*
DATE DRILLED: *11/14/2025*	BORING DEPTH (feet): *25*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. Groundwater level was not measured after 24 hours (NGWE). 3. Borehole caved to a depth of 18.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		3" - Topsoil	1171	
		RESIDUUM: Very stiff red brown micaceous silty CLAY (CL)		28
		Hard to very stiff red brown micaceous CLAY (CL)		31
5			1166	18
		Firm to stiff red brown fine sandy SILT (ML), wet		8
10			1161	
				14
15			1156	
		Medium dense gray brown micaceous silty fine SAND (SM), wet		27
20			1151	
		PARTIALLY WEATHERED ROCK: No Sample Recovery		50/0"
25		Auger Refusal at 25 feet	1146	

STANDARD PENETRATION RESISTANCE (blows/ft)

2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

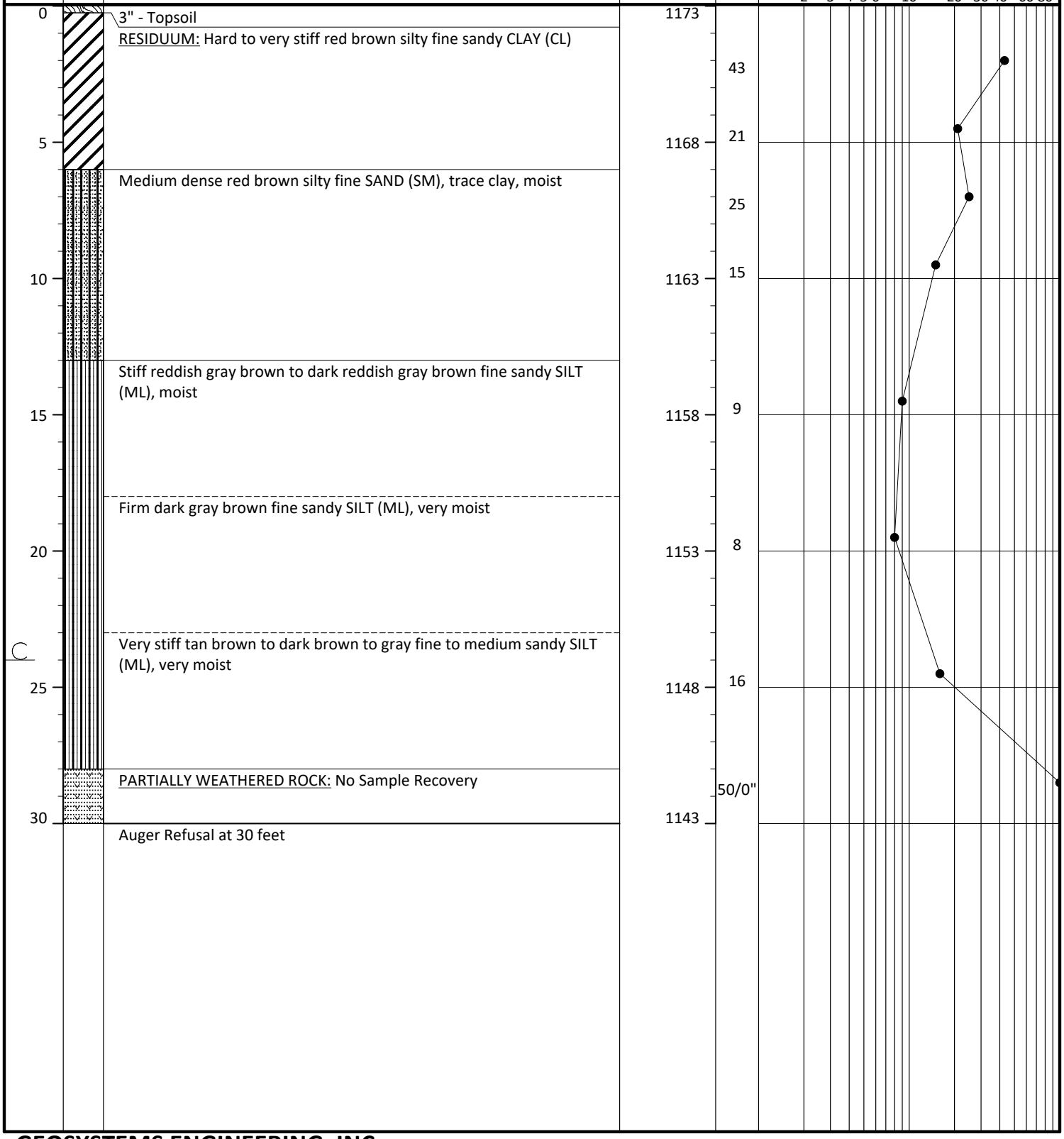
LOG OF BORING B-5

GEOLOGIST: *NA*	ELEVATION (feet): *1173*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *30*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater was encountered after 24 hours.(NGWE). 3. Borehole caved to a depth of 24 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1173	
	RESIDUUM: Hard to very stiff red brown silty fine sandy CLAY (CL)		43
5		1168	21
	Medium dense red brown silty fine SAND (SM), trace clay, moist		25
10		1163	15
	Stiff reddish gray brown to dark reddish gray brown fine sandy SILT (ML), moist		
15		1158	9
	Firm dark gray brown fine sandy SILT (ML), very moist		
20		1153	8
	Very stiff tan brown to dark brown to gray fine to medium sandy SILT (ML), very moist		
25		1148	16
	PARTIALLY WEATHERED ROCK: No Sample Recovery		50/0"
30	Auger Refusal at 30 feet	1143	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

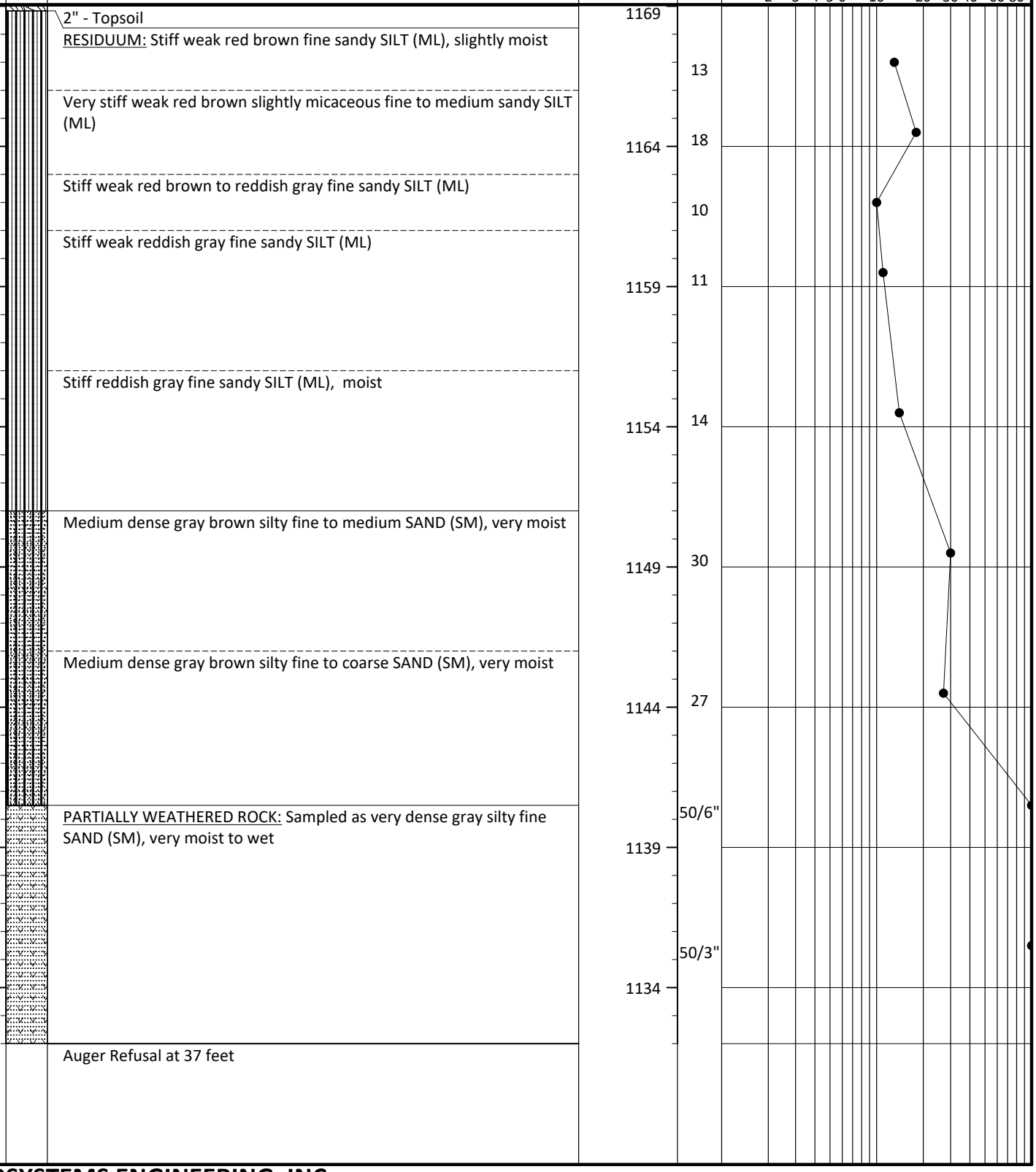
LOG OF BORING B-6

GEOLOGIST: *NA*	ELEVATION (feet): *1169*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *37*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater was encountered after 24 hours(NGWE). 3. Borehole caved to a depth of 24.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	2" - Topsoil	1169	
	RESIDUUM: Stiff weak red brown fine sandy SILT (ML), slightly moist		13
	Very stiff weak red brown slightly micaceous fine to medium sandy SILT (ML)		18
5		1164	
	Stiff weak red brown to reddish gray fine sandy SILT (ML)		10
	Stiff weak reddish gray fine sandy SILT (ML)		11
10		1159	
	Stiff reddish gray fine sandy SILT (ML), moist		14
15		1154	
	Medium dense gray brown silty fine to medium SAND (SM), very moist		30
20		1149	
	Medium dense gray brown silty fine to coarse SAND (SM), very moist		27
25		1144	
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine SAND (SM), very moist to wet		50/6"
30		1139	
			50/3"
35		1134	
	Auger Refusal at 37 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-7

GEOLOGIST: *NA*	ELEVATION (feet): *1173*
DATE DRILLED: *11/11/2025*	BORING DEPTH (feet): *67*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *33* 24HR (feet): *32*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	2" - Topsoil	1173	
	FILL: Firm brown slightly micaceous fine to medium sandy SILT (ML)		5
5		1168	5
			7
	Very stiff brown slightly micaceous fine to medium sandy SILT (ML), with rock fragments (Rocky)		28
10		1163	
	Stiff to very stiff brown slightly micaceous fine to medium sandy SILT (ML) (Rocky)		15
15		1158	
			19
20		1153	
	Loose reddish brown slightly micaceous silty fine to medium SAND (SM), slightly moist		9
25		1148	
	Soft reddish brown CLAY (CH), moist		4
30		1143	
	RESIDUUM: Firm yellow brown to gray brown fine sandy micaceous SILT (ML), wet		6
35		1138	
			6
40		1133	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

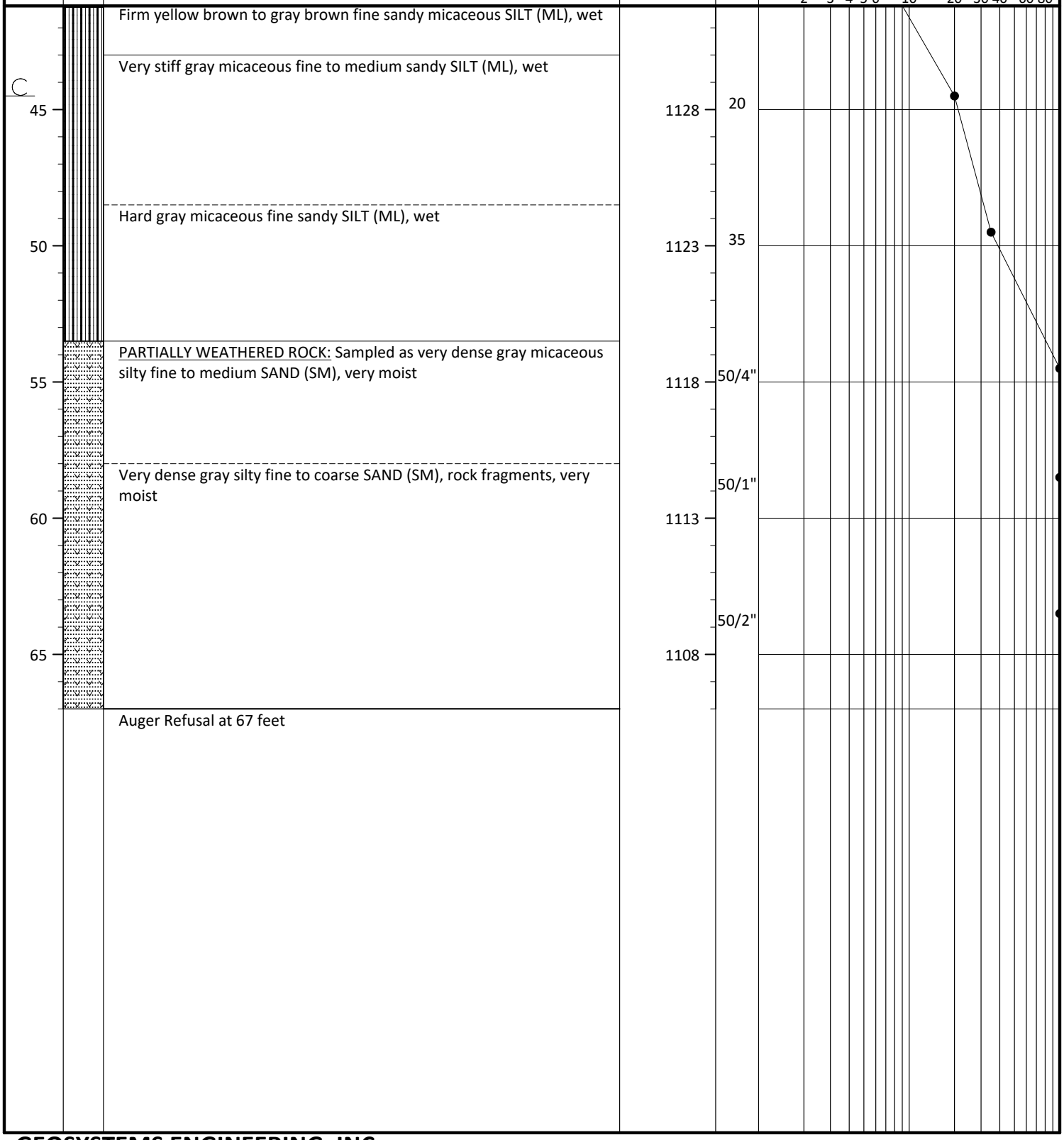
LOG OF BORING B-7

GEOLOGIST: *NA*	ELEVATION (feet): *1173*
DATE DRILLED: *11/11/2025*	BORING DEPTH (feet): *67*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *33* 24HR (feet): *32*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 33 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
		Firm yellow brown to gray brown fine sandy micaceous SILT (ML), wet		
		Very stiff gray micaceous fine to medium sandy SILT (ML), wet		
45			1128	20
		Hard gray micaceous fine sandy SILT (ML), wet		
50			1123	35
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray micaceous silty fine to medium SAND (SM), very moist		
55			1118	50/4"
		Very dense gray silty fine to coarse SAND (SM), rock fragments, very moist		50/1"
60			1113	
				50/2"
65			1108	
		Auger Refusal at 67 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

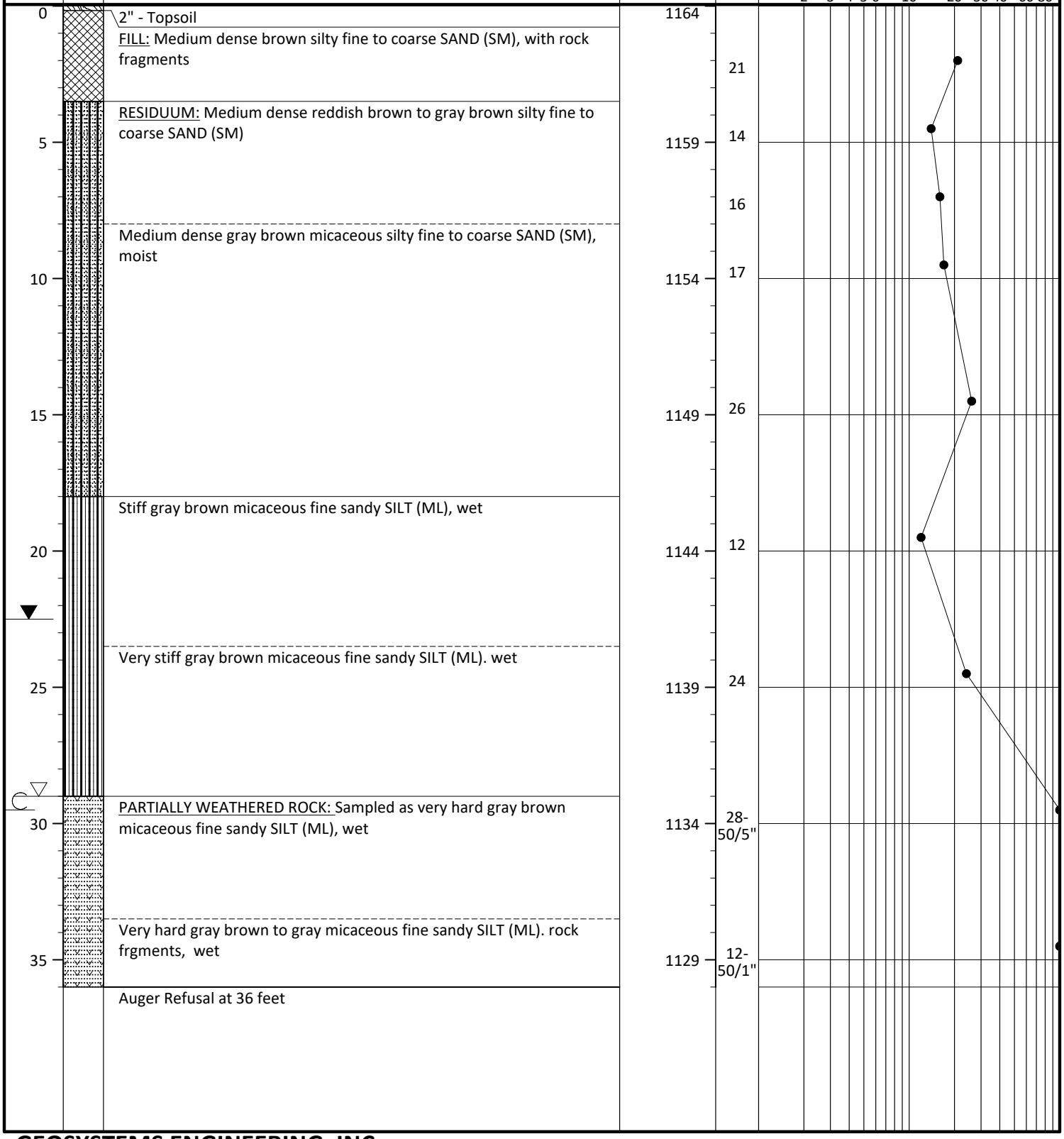
LOG OF BORING B-8

GEOLOGIST: *NA*	ELEVATION (feet): *1164*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *36*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *29* 24HR (feet): *22.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 29 feet at the time of boring. 2. Stabilized groundwater level measured at 22.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 29.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	2" - Topsoil	1164	
	FILL: Medium dense brown silty fine to coarse SAND (SM), with rock fragments		21
5	RESIDUUM: Medium dense reddish brown to gray brown silty fine to coarse SAND (SM)	1159	14
			16
	Medium dense gray brown micaceous silty fine to coarse SAND (SM), moist		17
10		1154	
15		1149	26
	Stiff gray brown micaceous fine sandy SILT (ML), wet		
20		1144	12
	Very stiff gray brown micaceous fine sandy SILT (ML). wet		
25		1139	24
30	PARTIALLY WEATHERED ROCK: Sampled as very hard gray brown micaceous fine sandy SILT (ML), wet	1134	28-50/5"
	Very hard gray brown to gray micaceous fine sandy SILT (ML). rock frgments, wet		
35		1129	12-50/1"
	Auger Refusal at 36 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-9

GEOLOGIST: *NA*	ELEVATION (feet): *1174*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *45*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *34* 24HR (feet): *34*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 34 feet at the time of boring. 2. Stabilized groundwater level measured at 34 feet 24 hours after drilling. 3. Borehole caved to a depth of 36.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1174	
	RESIDUUM: Stiff red brown fine sandy CLAY (CL) , moist		15
	Very stiff red brown fine sandy SILT (ML), slightly moist		16
5		1169	
	Stiff weak red brown fine sandy SILT (ML), moist		12
	Stiff red brown fine sandy SILT (ML), slightly moist		12
10		1164	
	Very stiff brown slightly micaceous fine sandy SILT (ML), moist		20
15		1159	
	Medium dense gray brown silty fine to medium SAND (SM), moist		12
20		1154	
			16
25		1149	
	Dense gray brown silty fine SAND (SM), moist		38
30		1144	
	Medium dense gray brown silty fine to medium SAND (SM), rock fragments, moist		24
35		1139	
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to medium SAND (SM), moist		50/5"
40		1134	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-9

GEOLOGIST: *NA*	ELEVATION (feet): *1174*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *45*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *34* ▼ 24HR (feet): *34*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 34 feet at the time of boring. 2. Stabilized groundwater level measured at 34 feet 24 hours after drilling. 3. Borehole caved to a depth of 36.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft) 2 3 4 5 6 10 20 30 40 60 80
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to medium SAND (SM), moist		50/0"	
45		Auger Refusal at 45 feet	1129		

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

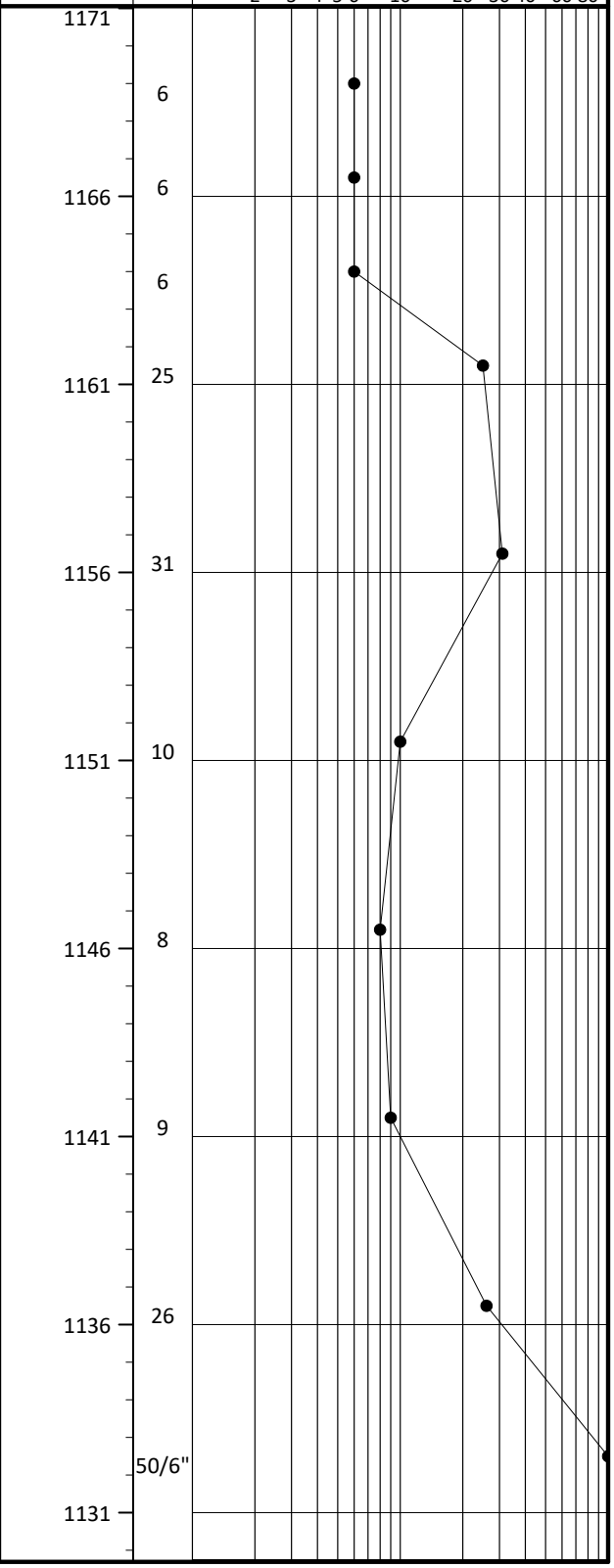
LOG OF BORING B-10

GEOLOGIST: *NA*	ELEVATION (feet): *1171*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *47*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *40* 24HR (feet): *32*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 40 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 39.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	2" - Topsoil	1171	
	FILL: Firm brown silty fine to coarse SAND (SM), with rock fragments		6
5		1166	6
	No Recovery		6
	Medium dense brown slightly micaceous silty fine SAND (SM) to sandy rock fragments (GP)(Rocky)		
10		1161	25
	RESIDUUM: Dense weak red brown silty fine to coarse SAND (SM), rock fragments		31
15		1156	
	Stiff reddish brown slightly micaceous fine sandy SILT (ML), slightly moist		
20		1151	10
	Firm to stiff brown slightly micaceous fine sandy SILT (ML), moist		
25		1146	8
30		1141	9
	Very stiff brown slightly micaceous fine sandy SILT (ML), moist		
35		1136	26
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine to medium SAND (SM), rock fragments, moist		50/6"
40		1131	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-10

GEOLOGIST: *NA*
ELEVATION (feet): *1171*
DATE DRILLED: *11/12/2025*
BORING DEPTH (feet): *47*
DRILLER: *GRINDSTONE DRILLING*
WATER LEVEL ▽ TOB (feet): *40* ▼ 24HR (feet): *32*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*

NOTES: 1. Groundwater detected at 40 feet at the time of boring. 2. Stabilized groundwater level measured at 32 feet 24 hours after drilling. 3. Borehole caved to a depth of 39.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft) 2 3 4 5 6 10 20 30 40 60 80
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray brown silty fine to medium SAND (SM), rock fragments, moist			
45		Very dense gray brown silty fine to medium SAND (SM), moist	1126	39-50/3"	
		Auger Refusal at 47 feet			

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

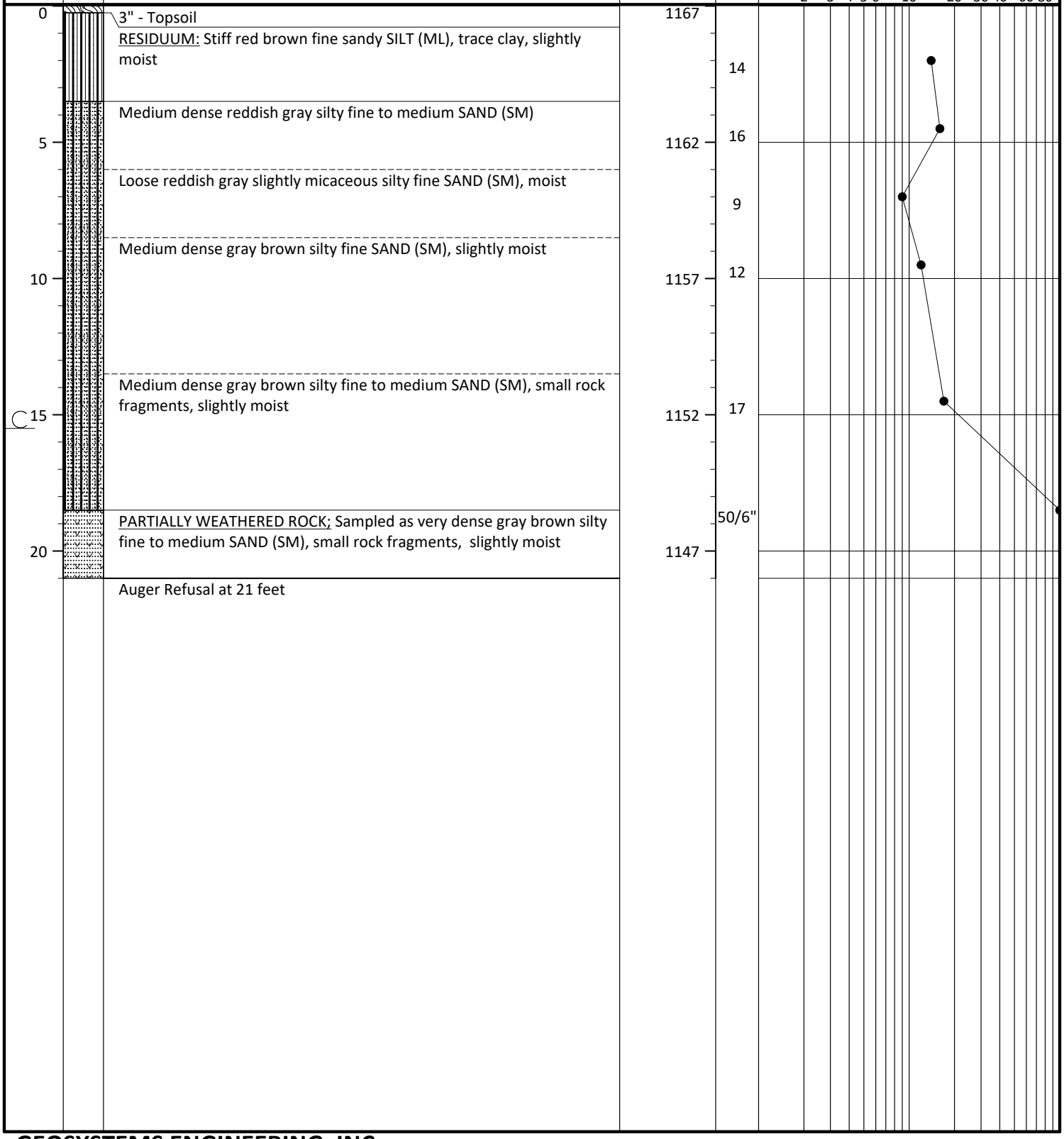
LOG OF BORING B-11

GEOLOGIST: *NA*	ELEVATION (feet): *1167*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *21*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater was encountered after 24 hours(NGWE). 3. Borehole caved to a depth of 15.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1167	
	RESIDUUM: Stiff red brown fine sandy SILT (ML), trace clay, slightly moist		14
5	Medium dense reddish gray silty fine to medium SAND (SM)	1162	16
	Loose reddish gray slightly micaceous silty fine SAND (SM), moist		9
	Medium dense gray brown silty fine SAND (SM), slightly moist		12
10		1157	
	Medium dense gray brown silty fine to medium SAND (SM), small rock fragments, slightly moist		17
15		1152	
	PARTIALLY WEATHERED ROCK; Sampled as very dense gray brown silty fine to medium SAND (SM), small rock fragments, slightly moist		50/6"
20		1147	
	Auger Refusal at 21 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-12

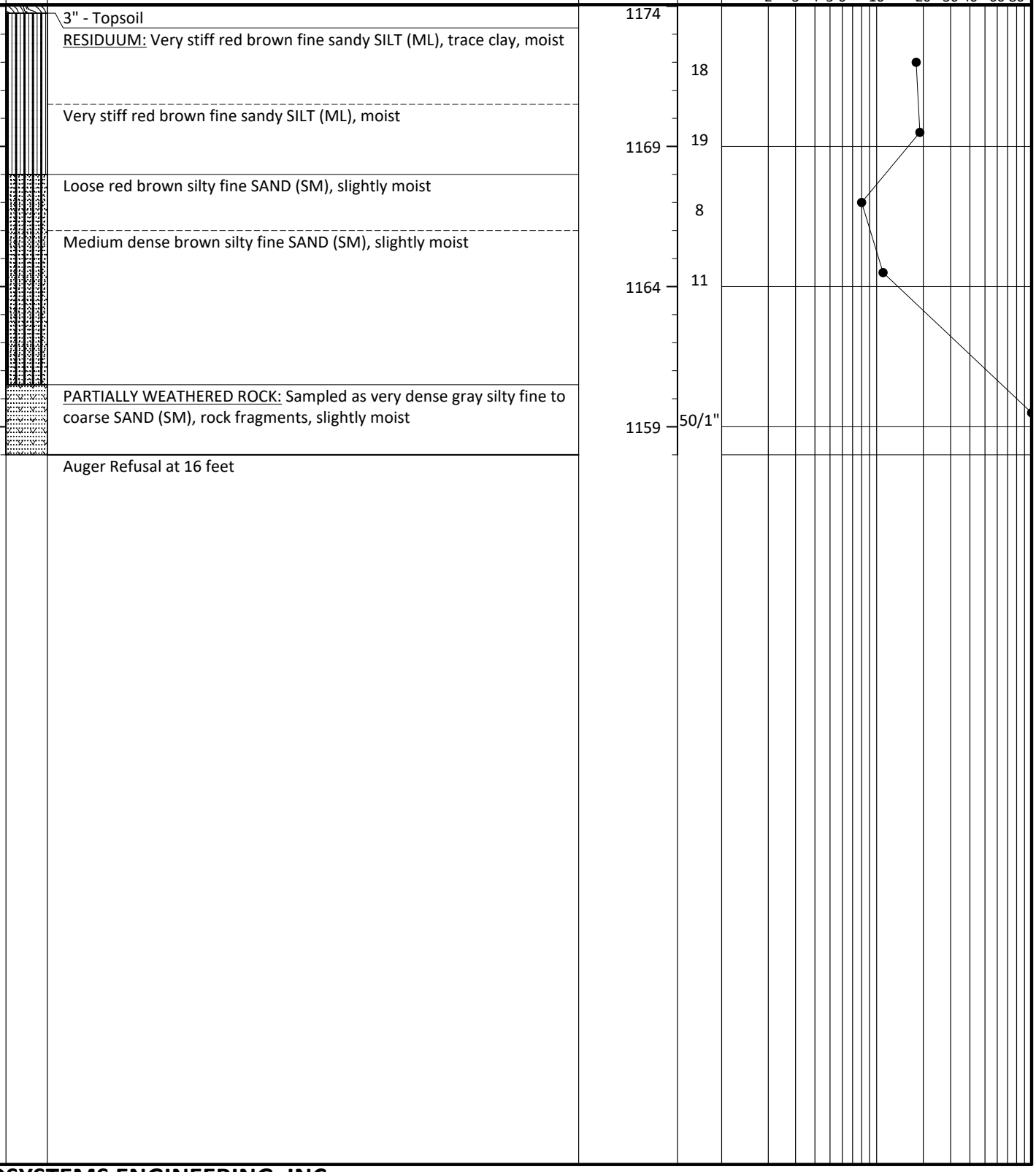
GEOLOGIST: *NA*	ELEVATION (feet): *1174*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *16*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater encountered after 24 hours (NGWE). 3. Borehole caved to a depth of 12.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		3" - Topsoil	1174	
		RESIDUUM: Very stiff red brown fine sandy SILT (ML), trace clay, moist		18
		Very stiff red brown fine sandy SILT (ML), moist		19
5			1169	
		Loose red brown silty fine SAND (SM), slightly moist		8
		Medium dense brown silty fine SAND (SM), slightly moist		11
10			1164	
		PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to coarse SAND (SM), rock fragments, slightly moist		50/1"
15			1159	
		Auger Refusal at 16 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)

2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

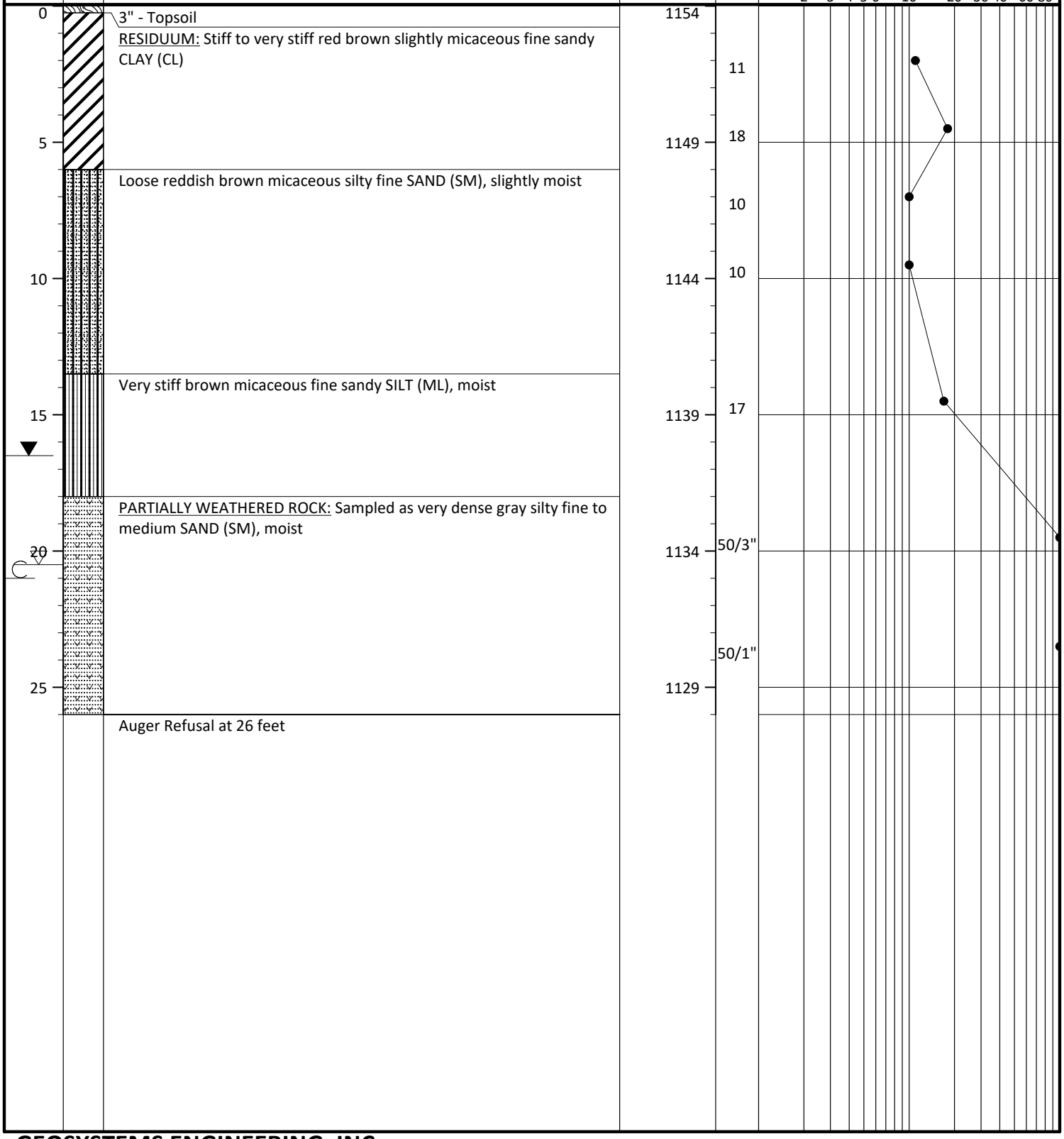
LOG OF BORING B-13

GEOLOGIST: *NA*	ELEVATION (feet): *1154*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *26*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *20.5* 24HR (feet): *16.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 20.5 feet at the time of boring. 2. Groundwater level measured at 16.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 20.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1154	
	RESIDUUM: Stiff to very stiff red brown slightly micaceous fine sandy CLAY (CL)		11
5		1149	18
	Loose reddish brown micaceous silty fine SAND (SM), slightly moist		10
10		1144	10
	Very stiff brown micaceous fine sandy SILT (ML), moist		17
15		1139	
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray silty fine to medium SAND (SM), moist		50/3"
20		1134	
			50/1"
25		1129	
	Auger Refusal at 26 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

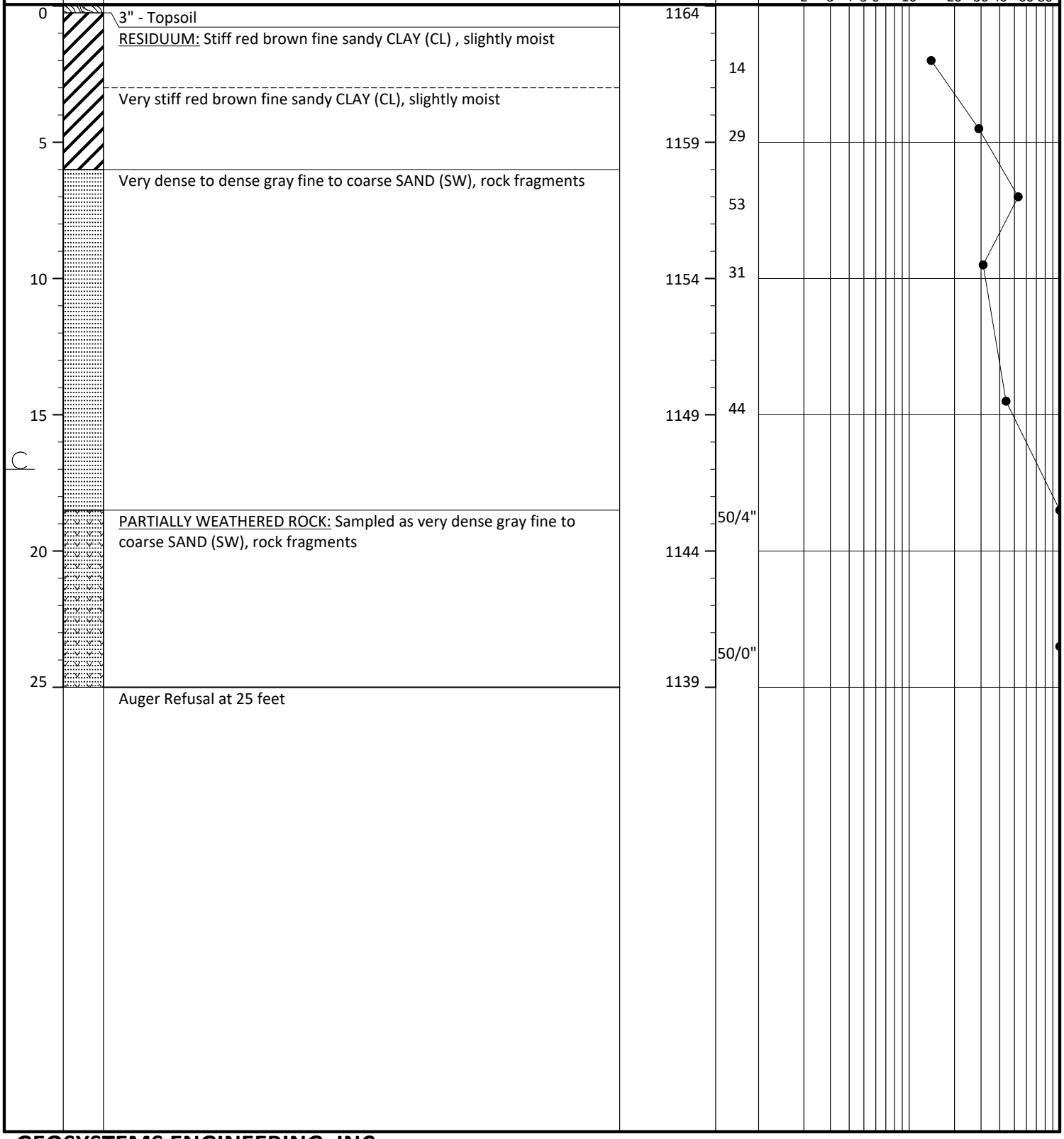
LOG OF BORING B-14

GEOLOGIST: *NA*	ELEVATION (feet): *1164*
DATE DRILLED: *11/12/2025*	BORING DEPTH (feet): *25*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *NGWE*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater detected at the time of boring (NGWE). 2. No groundwater encountered after 24 hours (NGWE). 3. Borehole caved to a depth of 17 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - Topsoil	1164	
	RESIDUUM: Stiff red brown fine sandy CLAY (CL) , slightly moist		14
	Very stiff red brown fine sandy CLAY (CL), slightly moist		29
5		1159	
	Very dense to dense gray fine to coarse SAND (SW), rock fragments		53
10		1154	31
15		1149	44
	PARTIALLY WEATHERED ROCK: Sampled as very dense gray fine to coarse SAND (SW), rock fragments		50/4"
20		1144	
			50/0"
25	Auger Refusal at 25 feet	1139	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

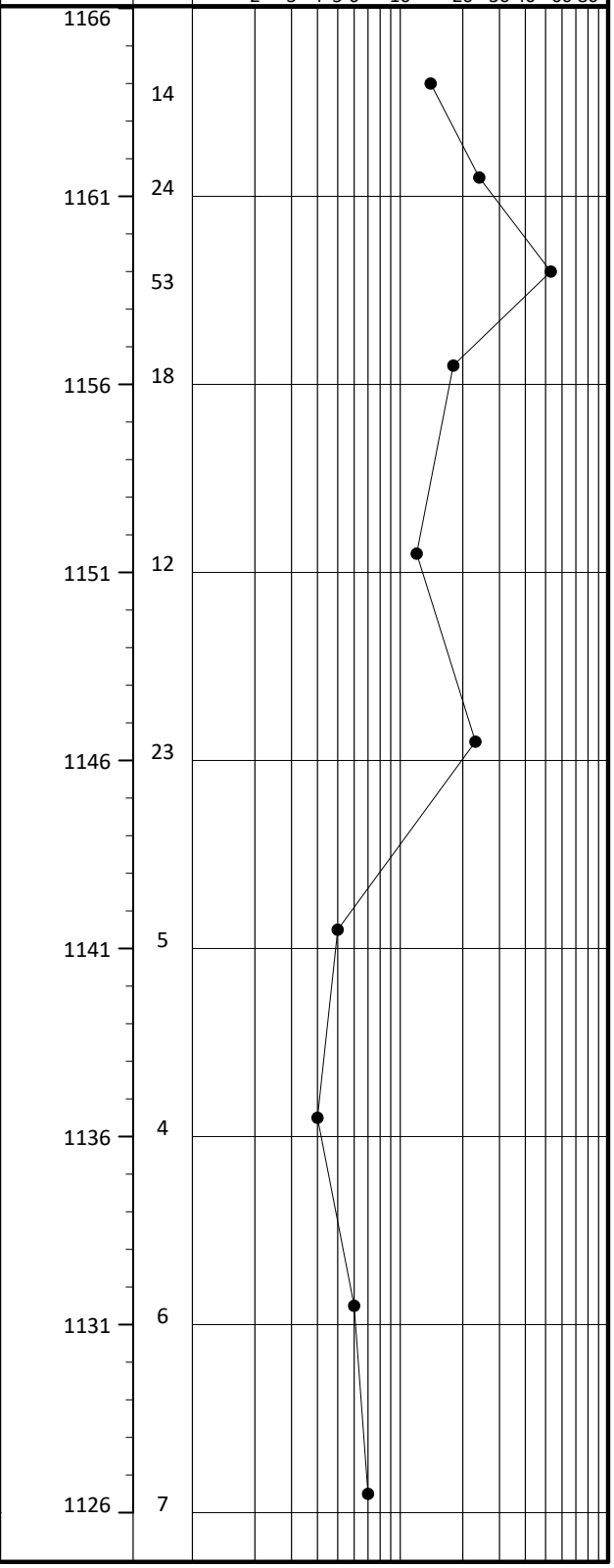
LOG OF BORING B-15

GEOLOGIST: *NA*	ELEVATION (feet): *1166*
DATE DRILLED: *11/11/2025*	BORING DEPTH (feet): *40*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *28* ▼ 24HR (feet): *26*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 28 feet at the time of boring. 2. Groundwater level measured at 26 feet 24 hours after drilling. 3. Borehole caved to a depth of 32 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - Topsoil	1166	
		FILL: Medium dense brown silty fine to coarse SAND (SM) and rock fragments (GP) (Rocky)		14
5			1161	24
		Very dense brown silty fine to coarse SAND (SM) and rock fragments (GP), slightly moist (Rocky)		53
		Medium dense brown to reddish brown silty fine to coarse SAND (SM), with rock fragments (Rocky)		18
10			1156	
		Medium dense brown silty fine to medium SAND (SM), slightly moist		12
15			1151	
		Medium dense brown silty fine to coarse SAND (SM) and rock fragments (GP)(Rocky)		23
20			1146	
		Loose reddish brown silty fine to coarse SAND (SM) and rock fragments (GP) (Rocky)		5
25			1141	
		RESIDUUM: Soft brownish gray slightly micaceous fine sandy SILT (ML), wet		4
30			1136	
		Firm gray micaceous fine sandy SILT (ML), wet		6
35			1131	
		Loose yellowish brown silty fine to medium SAND (SM), wet		7
40			1126	
		Boring Terminated at 40 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

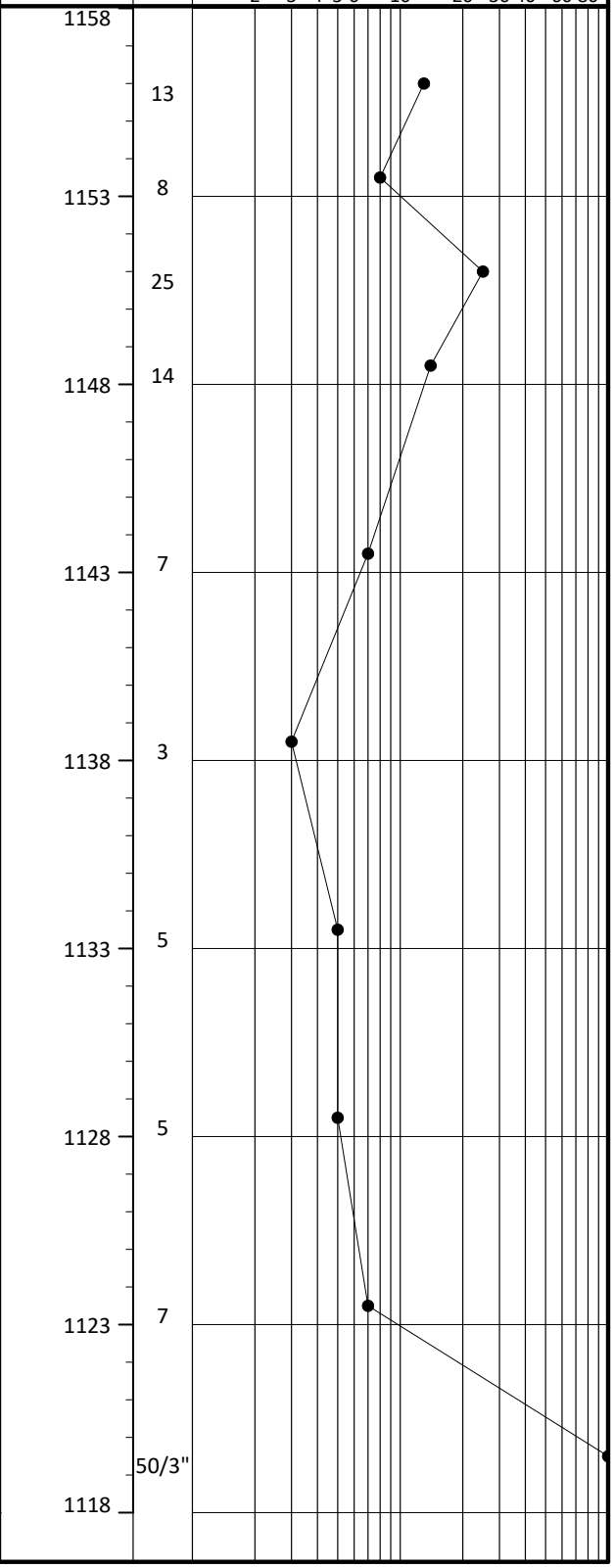
LOG OF BORING B-16

GEOLOGIST: *NA*	ELEVATION (feet): *1158*
DATE DRILLED: *11/11/2025*	BORING DEPTH (feet): *40*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *21.5* ▼ 24HR (feet): *20.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 21.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet 24 hours after drilling. 3. Borehole caved to a depth of 31.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - Topsoil	1158	
		FILL: Medium dense to loose tan brown silty fine SAND (SM), with rock fragments		13
5			1153	8
		Medium dense reddish brown to red silty fine to coarse SAND (SM), with rock fragments (Rocky)		25
		RESIDUUM: Stiff red brown fine sandy CLAY (CL), very moist		14
10			1148	
		Firm brown micaceous fine sandy SILT (ML), very moist		7
15			1143	
		Soft brown micaceous SILT (ML), very moist		3
20 ▼			1138	
▽		Firm brown slightly micaceous fine sandy SILT (ML), very moist		5
25			1133	
				5
30			1128	
				7
35			1123	
		PARTIALLY WEATHERED ROCK: Sampled as very dense grayish brown silty fine to medium SAND (SM), moist		50/3"
40		Boring Terminated at 40 feet	1118	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE II
FORSYTH COUNTY, GEORGIA

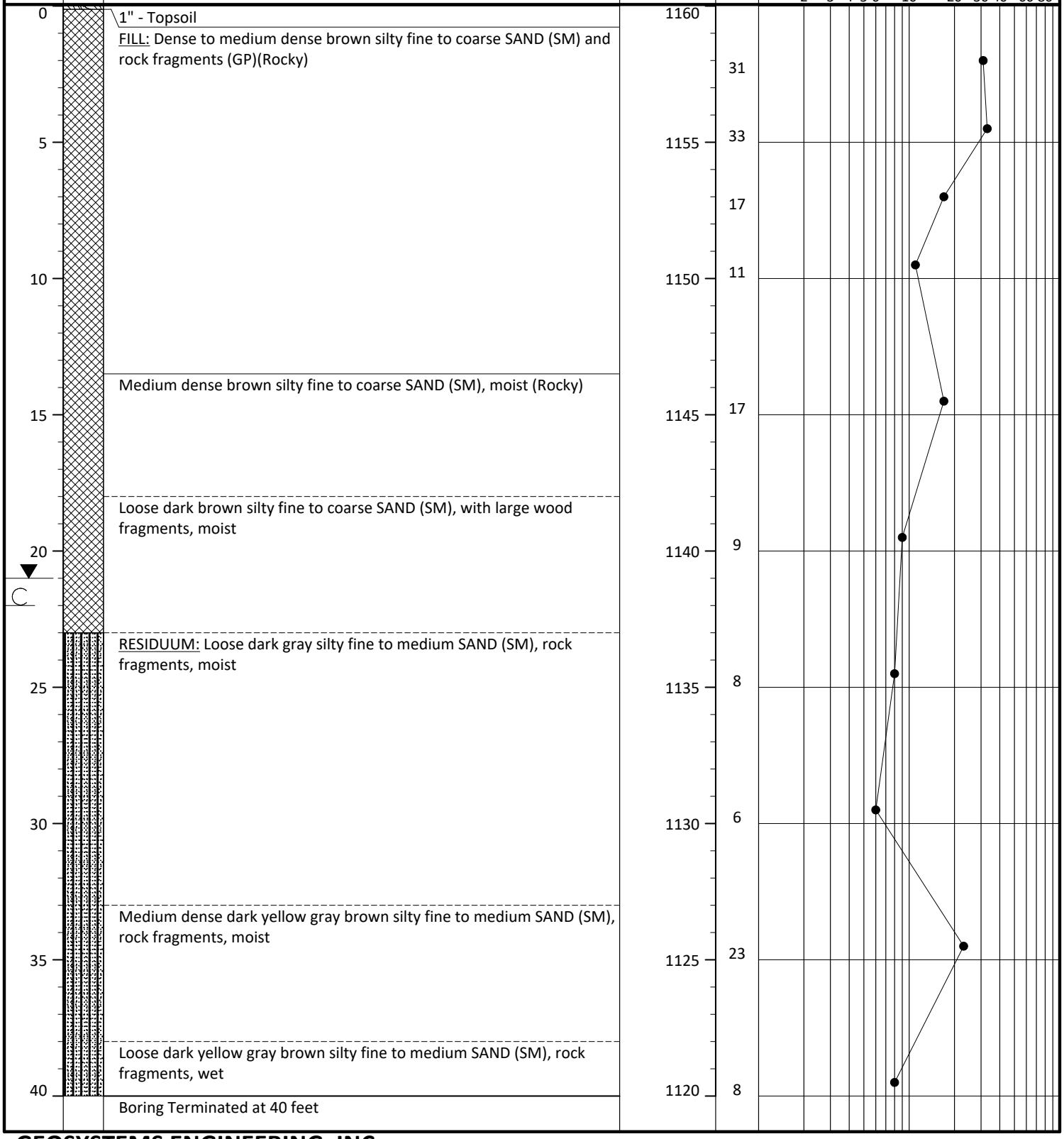
LOG OF BORING B-17

GEOLOGIST: *NA*	ELEVATION (feet): *1160*
DATE DRILLED: *11/11/2025*	BORING DEPTH (feet): *40*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *NGWE* 24HR (feet): *21*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. No groundwater encountered at the time of boring (NGWE). 2. Stabilized groundwater level measured at 21 feet 24 hours after drilling. 3. Borehole caved to a depth of 22 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	1" - Topsoil	1160	
	FILL: Dense to medium dense brown silty fine to coarse SAND (SM) and rock fragments (GP)(Rocky)		31
5		1155	33
			17
10		1150	11
	Medium dense brown silty fine to coarse SAND (SM), moist (Rocky)		
15		1145	17
	Loose dark brown silty fine to coarse SAND (SM), with large wood fragments, moist		
20		1140	9
	RESIDUUM: Loose dark gray silty fine to medium SAND (SM), rock fragments, moist		
25		1135	8
30		1130	6
	Medium dense dark yellow gray brown silty fine to medium SAND (SM), rock fragments, moist		
35		1125	23
	Loose dark yellow gray brown silty fine to medium SAND (SM), rock fragments, wet		
40	Boring Terminated at 40 feet	1120	8

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

APPENDIX C

2006 SUBSURFACE INVESTIGATION REPORT

GEOSYSTEMS
ENGINEERING, INC.

SUBSURFACE INVESTIGATION REPORT

CITY OF CUMMING, GEORGIA
6.0-MGD WATER TREATMENT PLANT EXPANSION
CUMMING, FORSYTH COUNTY, GEORGIA

Prepared for:

CITY OF CUMMING, GEORGIA
C/O CIVIL ENGINEERING CONSULTANTS, INC.
1225 JOHNSON FERRY ROAD, SUITE 855
MARIETTA, GEORGIA 30068

GeoSystems Project No. 06-1899
November 14, 2006

GEOSYSTEMS
ENGINEERING, INC.

November 14, 2006

City of Cumming, Georgia
c/o Nolan L. (Butch) Johnson, Jr., P.E.
Civil Engineering Consultants, Inc.
1225 Johnson Ferry Road, Suite 855
Marietta, Ga. 30068

Re: Subsurface Investigation
City of Cumming – Water Treatment Plant Expansion
Cumming, Forsyth County, Georgia
GeoSystems Project No. 06-1899

Dear Mr. Johnson:

In October 2006, GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. The primary purpose of this study was to determine subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The attached report describes the investigative procedures and presents the findings along with our evaluations and conclusions.

Thank you for giving us the opportunity to conduct the soil investigation for this project. We look forward to assisting you during the construction phase of the project. Please call us if we can be of any other help or if you have any questions.

Sincerely,

GeoSystems Engineering, Inc.

Phillip T. Jackson, E.I.T.
Staff Engineer

GEORGIA REGISTERED No. 11279 PROFESSIONAL ENGINEER LARRY D. MULLINS

Larry D. Mullins, P.E.
Principal Engineer

Copies Submitted: Addressee – 3

570 Colonial Park Drive • Suite 312 • Roswell, Georgia 30075 • (678) 722-0340 • Fax (678)722-0341

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY 1

INTRODUCTION 3
- Background 3
- Purpose 3
- Scope of Work 3
- Authorization 3

METHODOLOGY 3

SITE CONDITIONS 4
- Clearwell 4
- Package Plant 5
- Pump Station 5

AREA AND SITE GEOLOGY 5

SUBSURFACE CONDITIONS 6
- Clearwell 6
- Package Plant 7
- Pump Station 8

PROJECT INFORMATION 8

DESIGN RECOMMENDATIONS 9
- Seismic Design Criteria 9
- Foundations/Floor Slab Support 9
- Retaining/Below Grade Walls 11
- Pavements 12
- Slope Stability 12

CONSTRUCTION RECOMMENDATIONS 12
- Site Preparation 12
- Groundwater Control 13
- Difficult Excavation 14
- Earthwork 15
- Inspection 16

QUALIFICATION OF RECOMMENDATIONS 16

TABLE OF CONTENTS (Continued)

APPENDIX A:	FIELD AND LABORATORY PROCEDURES
APPENDIX B:	FIGURE 1 - BORING LOCATION PLAN FIGURE 2 - BORING LOCATION PLAN FIGURE 3 - BORING LOCATION PLAN KEY TO SYMBOLS AND CLASSIFICATIONS BORING LOGS (24)
APPENDIC C:	LABORATORY TEST REPORTS

EXECUTIVE SUMMARY

GeoSystems Engineering, Inc. (GeoSystems) has completed the authorized subsurface investigation for the planned 6.0-MGD Water Treatment Plant (WTP) expansion for the City of Cumming. The purpose of this study was to investigate subsurface conditions in areas planned for the expansion and provide recommendations for foundation design and construction. The following briefly summarizes the essential findings of the investigation and our recommendations:

1. The subsurface conditions encountered during this investigation include fill materials, alluvial deposits, residual soils, partially weathered rock and refusal material. Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal material. Residual soils, partially weathered rock, and refusal material underlie the proposed package plant location. Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. The residuum is generally typical of that found in the Piedmont Physiographic Province in which the site is located. Groundwater was encountered in all of the borings drilled in the clearwell and pump station portions of the site. Groundwater was not encountered at the time of boring at the package plant location.

2. On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.

3. We recommend the package plant foundations be designed to bear on the relatively strong residuum encountered in the borings for a maximum allowable soil bearing capacity of 5,000 psf. Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report.

4. We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. We recommend the foundation design be based on a maximum allowable bearing capacity of 2,000 pounds per square foot for the fill soils at the location of boring B-15. Foundation support at the alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.

5. Positive groundwater control must be performed during construction in order to allow shallow support of the clearwell. If groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water-softened soils and replacement with crushed stone will be necessary. Either vacuum well points or a deep well system are expected to be required to adequately lower and maintain the groundwater at required levels until construction is complete. Temporary observation wells should be installed at the site to confirm groundwater levels prior to excavation and to monitor drawdown at the location of the adjacent 2.0-MG clearwell. The contractor should be responsible for design of the dewatering system,

considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing structure will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary to avoid lowering the groundwater underneath the existing clearwell.

6. Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

These and supplementary recommendations relative to pavements, retaining walls, slopes, site preparation, and foundation construction are discussed in detail in the following report. This summary should not be used as a separate document or in lieu of the entire report, including the appendices.

INTRODUCTION

Background

GeoSystems Engineering, Inc. (GeoSystems) was contracted by the City of Cumming in October 2006 to provide a subsurface investigation for the planned 6.0-MGD expansion to the City's existing water treatment plant. Civil Engineering Consultants, Inc. (CEC) of Marietta, Georgia provided site plans and design information required for the investigation.

The existing water treatment plant is located on Dahlonega Road/Georgia Highway 9, about 2 miles north of downtown Cumming. The site is just north of Sawnee Drive at Sawnee Creek. The planned expansion will include a 6.0-MGD package plant with a backwash clearwell, a 3.0-MG clearwell , and a new pump station. The planned expansion areas are situated respectively in existing ball fields located at the southwest corner of the plant, in a filled area generally west of the existing 2.0-MG clearwell, and at the existing sludge lagoons located on the eastern side of Dahlonega Road.

Purpose

The purpose of the study was to investigate subsurface conditions in the areas planned for the expansion and to provide recommendations for the foundation design and construction.

Scope of Work

The scope of work for the geotechnical exploration consisted of visual reconnaissances of the site, sixteen soil test borings, collection of soil samples, field and laboratory soil permeability testing, laboratory soil classification analyses, evaluation of the field and laboratory data, and preparation of this report.

Authorization

Formal written authorization for the investigation was provided by Mr. Jonathon W. Heard, Director of Utilities, on October 5, 2006. At that time, Mr. Heard signed our standard "Agreement for Limited Professional Services" contract form on behalf of the City.

METHODOLOGY

Subsurface conditions at the site were investigated by drilling sixteen soil test borings (B-1 through B-15 and B-14A) at the approximate locations shown on the enclosed boring location plans (Figure 1 through Figure 3). The boring location plans were produced from an electronic copy of the topographic site plan that CEC provided to us. GeoSystems personnel established the boring locations in the field by measuring distances and estimating right angles from existing site features. Boring elevations in the package plant and the pump station areas were estimated to the nearest 1.0 foot by interpolating between contours shown on the provided site plan. Elevations of the borings in the new clearwell area were determined to the nearest 1 foot by an approximate engineering level survey. These elevations were referenced to a datum of 1144.5 feet for the pump pad located on the

southeastern edge of the existing 2.0-MG clearwell. Since our measurements were not precise, the referenced boring locations and elevations should be considered approximate.

The soil test borings were advanced, utilizing continuous flight hollow-stem augers, to termination or refusal depths varying approximately from 13 to 63 feet below the existing ground surface. Standard penetration testing and split-barrel sampling of the soils were conducted in the borings at regular intervals to evaluate relative density or consistency of the soils and obtain samples for classification. One undisturbed Shelby-tube sample was also recovered from each boring B-4 and B-5 to obtain representative samples for laboratory classification and hydraulic conductivity (permeability) testing.

Temporary piezometers (observation wells) were constructed at the locations of borings B-4 and B-5 to obtain stabilized groundwater levels and allow field permeability (slug) testing. The wells were constructed of 2-inch diameter solid PVC riser pipe with a 10-foot screened section at each location. The annular space around the screen was backfilled to 2 feet above the top of the screen with a clean, well-graded sand filter pack. A 2-foot bentonite clay seal was placed on top of the sand filter pack. The annulus around the riser pipe was filled to the ground surface with the soil cuttings from the borehole. Field permeability tests were performed in each well on November 3, 2006. These were rising head seepage tests performed by bailing water from the wells. The rate of rise of water in each well was recorded over time, and the soil permeability (horizontal) was calculated from the data in accordance with NAVFAC Design Manual (DM-7.01), 1987.

The split-barrel samples from the borings were classified in the field and preliminary boring records were prepared by the driller. In the laboratory, each sample was examined by a geotechnical engineer, and final detailed logs of the borings were prepared showing visual soil descriptions and unified classifications, standard penetration values, and groundwater levels (if encountered). In addition, laboratory grain size analyses and saturated hydraulic conductivity tests were conducted on representative split-barrel samples collected from boring B-1 and the Shelby-tube samples collected from borings B-4 and B-5. The laboratory soil grain size distribution analyses consisted of four tests in accordance with procedures described by ASTM D 422 for gradation, which refers to the grain size distribution in a soil plotted as a function of the percent by weight passing a given sieve size. Saturated hydraulic conductivity (vertical) testing consisted of flexible-wall permeability tests on relatively undisturbed soil samples extruded from the Shelby tubes.

Brief descriptions of the field and laboratory procedures are presented in Appendix A. The boring location plans and the soil test boring logs are included in Appendix B. Laboratory test data are attached in Appendix C.

SITE CONDITIONS

Clearwell

As noted previously, the new 3.0-MG clearwell will be located in a previously filled area to the west of the existing 2.0-MG clearwell. This location is currently undeveloped and overgrown with high grasses, weeds and pine seedlings/saplings. Site topography varies from nearly level to moderately sloping down to the east and south. Indicated relief from our level survey data is about 20 feet,

varying from a high elevation near 1162 feet over the western three-fourths of the clearwell footprint to a low elevation of 1142 at the southeast corner. The topography shown on the provided site plan appears to be in error in this area, as the higher portions of the footprint are indicated to be at elevations 1172 to 1177.

Package Plant

The planned package plant location is in an area currently occupied by the northernmost of four baseball fields. This area is at the southwest corner of the existing WTP. Within the package plant area, site topography is nearly level to very gently sloping down to the north. Indicated elevations are 1206 to 1204 feet. Ground cover is a sparse cover of grass and weeds with large areas of bare earth. A chain link fence surrounds most of the field.

Pump Station

There are two alternate locations being considered for the proposed pump station. Both locations are situated in the existing sludge lagoon area, on the east side of Dahlonega Road. One site is in the western end of Lagoon 1, which was in the process of being filled-in with dry settled solids waste from the existing plant at the time of the field investigation. The second site is at the eastern end of lagoon 1 on the grassed containment dike. The ground surface elevation at both pump station locations appears to be about 1145 feet.

AREA AND SITE GEOLOGY

The Cumming WTP is located within the northern Piedmont Physiographic Province, an area underlain by ancient igneous and metamorphic rocks of Paleozoic age. Published geologic mapping indicates that the site is underlain by metamorphic rocks of the Powers Ferry formation which includes undifferentiated biotite-quartz-plagioclase gneiss (metagraywacke), mica schist, and amphibolite.

The origin of the Paleozoic rocks, as sediments, has been obscured, due to their age and repeated cycles of weathering, metamorphism, folding, faulting, and injection with younger Paleozoic granites and Triassic diabase dikes. All of these rocks have weathered in place and are covered by a mantle of residual soils of varying thickness. Residual soils are formed insitu by chemical alteration of the underlying rocks. Normally, the weathering is most advanced near the ground surface and decreases with depth until unweathered parent rock is encountered. A transition from clay to silt to silty sand to partially weathered rock to hard rock is typical; however, this order of weathering is not always present. It is not uncommon to find layers or zones of partially weathered rock (PWR) or relatively unaltered rock within the soil mantle or weathered rock layers within the underlying parent rock mass. The naturally developed soil profile may be changed by erosion and/or man's grading activities, so that the upper more weathered zones may be completely stripped away. Also, residual soils may be covered by washed-in alluvial soils or manmade fill, or both.

The deeper residual materials retain the relict structure of the original rock. Partially weathered rock materials have the appearance of sands in which the sand grains are individual mineral crystals that occupy the same positions as in the unaltered rock. Individual crystal breakdown occurs with further

weathering and sandy silts or silty sands are formed. The original structures within the parent rock are preserved in these soils; however, the crystalline structure is altered or destroyed. Residual soils characterized by preservation of relict structures that were present in the unweathered rock are termed saprolites.

Groundwater in the Piedmont generally occurs under water table conditions as a result of infiltration of surface waters through the somewhat permeable overburden. Fractures and other discontinuities in the underlying rock can affect groundwater conditions. In this geologic setting, the configuration of the groundwater table is generally expected to be a slightly subdued replica of the ground surface. Localized groundwater flow roughly follows the flow of surface water. Although hydraulically connected to the water table aquifer, groundwater at depth in the rock is found in water-bearing fractures.

SUBSURFACE CONDITIONS

Clearwell

Within the proposed clearwell expansion area, the borings typically encountered an upper layer of fill overlying some alluvium, residual soils, partially weathered rock and refusal materials. Fill is any material that has been placed by man. Alluvium is material that has been transported and deposited by flowing water. Residual is a term used to define soils formed in-place by the chemical weathering process of the underlying rocks. Residual material that can be penetrated by power augers and exhibits standard penetration resistances of at least 100 blows per foot is termed partially weathered rock. Refusal is a designation applied to any material which cannot be further penetrated by the soil drilling process, and is normally indicative of a very hard or very dense material, such as boulders, rock lenses, or the upper surface of bedrock.

Fill was encountered at all boring locations from the ground surface to depths ranging approximately from a minimum of 6 feet in boring B-8 to a maximum of 26 feet in B-6. The fill was sampled generally as silty sand (SM) and sandy or clayey silt (ML-MH) with some clay (CL-CH) layers. Scattered throughout the fill are various quantities of gravel, rocks, wood and other organic matter at random depths and locations. Relative density or consistency of the fill soils varies appreciably as indicated by standard penetration resistances ranging from a minimum of 2 blows per foot (bpf) to 20 bpf. A 2.5 to 5-foot layer of alluvium or possible alluvial soils underlies 6 to 8.5 feet of fill at the locations of borings B-8 and B-3, respectively. The alluvium was sampled as firm gray silty clay (CL) in boring B-3.

Below the fill and alluvium layers, a relatively thick stratum of residual soils was encountered in the borings. The residual soils extend to the top of partially weathered rock at depths of 36 to 41 feet in borings B-1, B-2, B-3, and B-8. At the remaining locations, the residual soil stratum extended to boring termination or refusal depths varying from 50 to 63 feet below ground. The residual soils were visually classified as either micaceous silty sands (SM) or micaceous sandy silts (ML). The laboratory grain size analyses show the residual soil classification is predominantly silty sand (SM) with approximately 64 to 70 percent sand content. Relative density of the sandy residuum was typically loose to medium dense, but varied from very loose to dense. Consistency of the silts was

generally firm to stiff, but varied from soft to very stiff. Standard penetration resistances in these soils ranged from a minimum of 2 to a maximum of 32 bpf.

Saturated hydraulic conductivity of the residual soils was measured vertically by the laboratory tests on undisturbed samples and horizontally by the field seepage tests conducted in the observation wells. The laboratory tests were conducted on sections of undisturbed samples recovered from a depth interval of 42 to 44 feet below ground. Average permeability of a section of soil from 40 to 50 in depth (approximate) was measured in the wells. The test results are as follows:

LOCATION	METHOD	DEPTH (feet)	PERMEABILITY (K_v) (cm/sec)	PERMEABILITY (K_h) (cm/sec)
B-4	Laboratory	42 - 44	5.6E-05	
B-4	Field	40 - 50		1.34E-04
B-5	Laboratory	42 - 44	2.8E-05	
B-5	Field	40 - 50		1.88E-04

At the locations of borings B-1, B-2, B-3, and B-8, 4 to 16 feet of continuous partially weathered rock was encountered in advance of auger refusal. The partially weathered rock materials were sampled as either very dense silty sand (SM) or very hard sandy silt (ML). Auger refusal materials were also encountered in borings B-4 and B-6 below the residual soil strata. Refusal depths in the borings varied approximately from 42 to 63 feet below the ground surface. Refusal encountered in the borings appears to be the top of bedrock within the clearwell location. However, rock coring procedures, which were beyond the scope of this investigation, would be required to determine the actual character and continuity of the refusal materials.

Stabilized groundwater levels were measured in borings B-1, B-4, B-5, B-6, and B-7 at a depth of approximately 23 feet below the existing ground surface. Time of boring groundwater levels were detected in the remaining borings at depths varying approximately from 5 to 25 feet below ground. In general, the groundwater level measurements correlate to a water table elevation in the range of 137 to 1140 feet. Groundwater levels are subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than those reported during this study.

Package Plant

The borings show that residual soils, partially weathered rock, and refusal materials underlie the proposed package plant location. These soils, described mainly as medium dense to very dense silty sand (SM) and very stiff to very hard sandy silt (ML), were encountered at or near the ground surface at all boring locations. Within the residual soils, standard penetration resistances varied from a minimum of 15 to a maximum of 69 bpf. Except at the location of B-11, the residual soil stratum continued to boring termination depths of 15 and 25 feet. Continuous partially weathered rock was encountered in boring B-11 from below the residual soils at a depth of 31 feet to auger refusal at 37 feet. Layers of PWR were also penetrated within the residual soil stratum from 3 to 11 feet in B-11 and from 8 to 11 feet in boring B-12. Refusal, which appears to be the upper surface of bedrock, occurred only at the location of boring B-11.

No groundwater was encountered in any of the package plant borings at the time of our field investigation. Again, we note that groundwater conditions at other locations or at other times may be different than those reported during this study.

Pump Station

Subsurface conditions at the two alternative pump station locations consist of fill overlying either residual soils or alluvium and then residual soils. An upper layer of fill was initially encountered to depths varying approximately from 13 feet at the location of boring B-14A to 6 feet at B-15. Boring B-14 encountered fill materials to auger refusal at a depth of 13 feet. At the location of borings B-14 and B-14A, the fill appears to be settled solids waste from the plant overlying wood debris. Refusal in boring B-14 appeared to be a tree trunk or stump. The settled solids waste, classified as soft clayey silt (MH), is currently being used to backfill the old lagoons. The fill in boring B-15, described as loose silty sand (SM), is associated with material previously placed during construction of the lagoon dike. Penetration resistances in the fill were 1 and 2 bpf in the settled solids waste and 7 and 9 bpf in the dike soils.

Below the fill in boring B-15, an approximate 10-foot layer of alluvium was encountered. The upper 5 feet of alluvium appears to be a soft sandy silt (ML). The lower 5 feet was described as a medium dense clayey sand (SC) with organic matter. Standard penetration resistances in these soils were 3 and 4 bpf in the silt and 15 bpf in the sand.

Residual soils were encountered below the fill in boring B-14A and below the alluvium in B-15. The residuum consisted of a dense silty sand (SM) that extended to boring termination depths of 15 and 20 feet, respectively. Standard penetration resistances in the residual soils were 39 and 28 bpf.

Groundwater levels at the time of boring were at depths of 4 feet in borings B-14 and B-14A and 9 feet in boring B-15.

PROJECT INFORMATION

Our understanding of this project is based on previous discussions with Mr. Butch Johnson and Mr. To Nguyen of Civil Engineering Consultants, review of the provided topographic site layout plan, and our field observations of the expansion areas. The expansion will include a 3.0-MG clearwell, a 6.0-MGD package plant with a backwash clearwell, and a pump station.

The new 3.0-MG clearwell will be located in the northwest corner of the site, immediately west of the existing 2.0-MG clearwell. We understand the new clearwell will be a rectangular, 142-foot by 296-foot, reinforced concrete structure. The top of the clearwell will be at elevation 1144.5 and the bottom slab at 1130.0 feet. Plans are to use an 18-inch thick bottom slab underlain by 3 feet of Class "C" concrete. The completed structure will be buried under 3 to 4 feet of soil backfill. Structural loading conditions have not been provided for the clearwell; however, the design indicates a foundation contact pressure for the base slab on the order of 1,500 to 2,000 psf. Significantly higher loads under the exterior walls and interior columns are expected. Based upon existing grades from

our field survey, cuts varying approximately from a maximum of 37 to a minimum of 17 feet are indicated to be required to achieve the planned clearwell bottom elevation.

The new package plant will be located in the baseball field area, southwest of the existing WTP plant. The plant building will be a rectangular, 83-foot by 136-foot, one-story metal structure with a soil supported (slab-on-grade) floor slab. A 28-foot square backwash clearwell will be located outside the northeast corner and a 10,000-gallon lime storage tank outside the southwest corner. Three treatment tanks, each 15 feet wide by 48 feet long by 10 feet high and weighing 456 kips, will be located in the plant building. These will be supported on approximately 24-inch thick slabs at the finish floor elevation. The planned finish floor elevation is 1206.0 feet, roughly zero to 2 feet above the indicated existing site grades. The bottom of the backwash clearwell will be at elevation 1189.5, which will require an excavation of about 15 or 16 feet.

Foundation loading conditions for the new building are expected to be light, not exceeding 100 kips for individual footings and 2 to 3 kips per linear foot for walls. Floor loading underneath the treatment tanks will be on the order of 600 to 700 psf.

Two alternate locations for the new pump station are being considered in the existing sludge lagoon area, on the eastern side of Highway 9. The station will generally be a relatively light slab-on-grade structure containing three pumps. The slab will be placed near the existing site grade.

DESIGN RECOMMENDATIONS

Seismic Design Criteria

The International Building Code (IBC) includes provisions for categorizing the upper 100 feet of the subsurface profile for use in evaluating potential seismic forces resulting from an earthquake. Although subsurface conditions to a depth of 100 feet were not investigated at this site, the available subsurface information and our previous experience indicate the average standard penetration resistance to this depth would generally be in the range of 15 to 50 blows per foot. Based on this information and the IBC definitions (Table 1615.1.1), the site is categorized as Site Class D (stiff soil profile).

Foundations/Floor Slab Support

In general, the undisturbed residual materials encountered in the planned clearwell and package plant locations should provide adequate long-term foundation support for the range of structural loads anticipated. Subject to recommendations in this report, the proposed clearwell and package plant structures may, therefore, be designed for conventional shallow slab-on-grade foundations, continuous footings or individual column footings bearing in existing undisturbed residual soils or partially weathered rock. Available bearing capacities in the residuum vary considerably from a low of about 2,000 psf in the weak soils found in the clearwell location to a high of 10 ksf or more in the partially weathered rock materials found in both the clearwell and package plant areas.

We recommend the new pump station be sited at the location of boring B-15, where shallow foundation support on the existing fill soils may be accomplished. Foundation support at the

alternative location (B-14 and B-14A) would require either difficult dewatering and excavation and replacement of unsuitable materials, or a deep foundation system.

Clearwell. Foundation support of the clearwell will be influenced by construction below the water table and areas of relatively weak residual soils at the planned foundation bearing level. The micaceous silts and sands encountered at the clearwell location are extremely sensitive to moisture and are subject to "quick" soil conditions or loss of strength in excavations below the water table. Therefore, positive groundwater control, as subsequently discussed in this report, must be performed during construction in order to allow shallow support of the clearwell. If the groundwater control measures are inadequate, deep foundation support may become necessary as the only means of repairing water damage to the subgrade. Even with positive dewatering, localized undercutting of water softened soils and replacement with crushed stone will be necessary.

On completion of effective site dewatering, excavation to planned grade, and stabilization of the exposed soils, the clearwell may be supported by the planned conventional shallow slab foundation bearing on the prepared subgrade. We recommend that a maximum allowable soil bearing capacity of 2,000 psf be used for design of the clearwell individual column or continuous wall footings.

Package Plant. Based on the relatively strong residuum encountered in the borings, we recommend the package plant foundations be designed for a maximum allowable soil bearing capacity of 5,000 psf for static loading conditions. Minimum widths of 24 inches for any individual column footings and 18 inches for continuous wall footings should be used for practical construction considerations and to reduce the possibility of localized foundation shear failures. Exterior footings should be placed at least 12 inches below final exterior grades to assure that foundations bear below the possible frost penetration depth.

Floor or grade slabs may be soil supported subject to site preparation and earthwork recommendations contained in this report. Building grade slabs should be jointed around columns and along footing-supported walls to minimize cracking due to possible differential movements. As an alternative to flat grade slabs and conventional spread footings, monolithic turned-down slabs-on-grade may be used. Turned-down slabs should be thickened underneath columns and load bearing walls and have adequate reinforcement in order to minimize cracking between the thickened and flat portions of the slab.

Pump Station. Based upon the boring data, we conclude that the expected light foundation load imposed by the planned pump station foundation slab can be supported on the existing fill soils at the location of boring B-15. We recommend the foundation design be based on a maximum allowable soil bearing capacity of 2,000 pounds per square foot for the existing fill conditions. The slab should bear at least 12 inches below finish grade. Shallow foundation support of the pump station slab is subject to the subsequent construction recommendations in this report.

Retaining/Below Grade Walls

Earth pressures on walls below grade are influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The most common conditions assumed for earth retaining wall design are the active and at-rest conditions. Active conditions apply to relatively flexible earth retention structures, such as free-standing walls, where some movement and rotation may occur to mobilize soil shear strength. Walls that are rigidly restrained, such as basement, pit and tunnel walls, should be designed for the at-rest condition. A third condition, the passive state, represents the maximum possible pressure when a structure is pushed against the soil, and is used in wall foundation design to help resist active or at-rest pressures. Since significant wall movements are required to develop the passive pressure, the total calculated passive pressure should be reduced by one-half to two-thirds for design purposes.

Based on previous experience with similar soils and construction, we recommend the following earth pressure coefficients and equivalent fluid pressures for design of retaining or below grade walls:

EARTH PRESSURE CONDITIONS	COEFFICIENT	RECOMMENDED EQUIVALENT FLUID PRESSURE (PCF)
Active (K_A)	0.33	40
At-Rest (K_O)	0.50	60
Passive (K_P)	3.00	---

A moist soil unit weight of 120 pounds per cubic foot should be used for design calculations. Our recommendations assume that the finish ground surface outside the walls will be level and that silty sand or other granular backfill will be utilized. A surcharge should be added to the earth pressure if the ground surface slopes up from the top of the wall. To calculate resistance to sliding, a value of 0.35 (includes a factor of safety of 1.5) should be used as the coefficient of friction between wall foundations and the underlying soil.

The recommended equivalent fluid pressures assume that constantly functioning drainage systems are installed between walls and soil backfill to prevent the accidental buildup of hydrostatic pressures and lateral stresses in excess of those stated. If a functioning drainage system is not installed, then lateral earth pressures should be determined using the buoyant weight of the soil (57.6 pcf). Hydrostatic pressures calculated with the unit weight of water (62.4 pcf) should be added to these earth pressures to obtain the total stresses for design.

Tractors and other heavy equipment should not operate within 10 feet of below grade walls to prevent lateral pressures in excess of those cited. If footings or other surcharge loadings are located a short distance outside below grade walls, they may also exert appreciable additional lateral pressures. If an imaginary line projected downward at a 45-degree angle from the bottom near edge of the surcharge load does not intersect the wall, the effect of the load on the wall may be neglected.

Whenever this line intersects the wall, the effect of the surcharge loads should be added to the recommended earth pressures to determine total lateral stresses. Foundation bearing levels may also be lowered to eliminate increased stresses on adjacent retaining walls.

Pavements

Strength testing of subgrades was not performed during this study; however, local experience with similar soils indicate typical CBR values in the range of 3 to 5. Based on these subgrade strength values and AASTHO design guidelines, we recommend the following minimum flexible asphalt pavement alternatives:

1. For parking lots and drives restricted to automobile traffic, a light-duty section consisting of 6 inches of crushed stone base course overlain by 2 inches of asphaltic surface course.

2. For parking lots and drives subject to both automobile and occasional truck traffic, a heavy-duty section consisting of 8 inches of crushed stone base course overlain by 1.5 inches of asphaltic binder course and 1.5 inches of asphaltic surface course.

The recommended pavement design sections are subject to successful completion of the site and subgrade preparation and fill placement operations as recommended in this report. We note that the compaction quality and gradation of the crushed stone base will directly affect the quality and life of the flexible pavement section. Consequently, we recommend a minimum compaction of 100 percent of the maximum dry density for the crushed stone material as determined by the modified Proctor compaction test (ASTM D-1557, Method D). A qualified soils engineering technician working under the direction of a geotechnical engineer should observe placement and compaction of the base coarse material and perform field density tests to confirm that the material has been placed in accordance with our recommendations. The crushed stone aggregate utilized in the base should conform with section 815 of the State of Georgia, Department of Transportation Standard Specifications for Road and Bridge Construction. In addition, all pavement materials and paving operations should meet applicable specifications of the Georgia Department of Transportation.

Slope Stability

Our exploration did not include a detailed analysis of slope stability for any temporary or permanent condition. However, within building, pavement and landscaped areas, we recommend temporary slopes no steeper than 1.5(H):1.0(V), and permanent slopes no steeper than 2.0(H):1.0(V) for construction in undisturbed residual soils or structural fill placed in accordance with our recommendations. A minimum setback from the top of all slopes of 10 feet is recommended for structures and 5 feet for pavements.

CONSTRUCTION RECOMMENDATIONS

Site Preparation

Prior to proceeding with construction operations, all vegetation, root systems, topsoil, and other deleterious non-soil materials should be stripped from the proposed construction areas. Clean topsoil

may be stockpiled and used to top dress slopes and other disturbed areas prior to permanent seeding and or stabilization. On completion of the stripping and rough grading, the areas intended to support floor slabs or pavements, new fill, and foundations should be carefully inspected by a qualified geotechnical engineer. Except for the new clearwell and pump station locations, engineering inspection should include observation of proofrolling of the subgrade utilizing a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proofrolling is to locate any soft, weak, or excessively wet soils which may be present at the time of construction. If unstable or unsuitable soils are found, some stabilization measures and/or undercutting and replacement with structural fill will likely be required in order to provide adequate subgrade and foundation support conditions.

Groundwater Control

As noted previously, no groundwater was detected in the borings drilled within the package plant location at the site. In the clearwell and pump station areas, groundwater was observed at all of the boring locations at depths varying approximately from 4 to 25 feet below ground. In general, the groundwater levels correlate to water table elevations ranging approximately from 1137 to 1140 feet within the clearwell and 1136 to 1141 at the two alternate pump station sites.

Construction Dewatering. Based on the indicated groundwater levels, temporary dewatering will be required at the clearwell location prior to excavation. Dewatering will be necessary in order to stabilize the excavation, achieve suitable working conditions, and prevent the loss of soil strength or "quick" soil conditions.

Groundwater control at this location will require a positive system of dewatering such as vacuum well points or a deep well system to adequately lower and maintain the groundwater at required levels until construction is complete. The dewatering system should be monitored and maintained around the clock to assure proper continuous operation and control. The system must also be supplemented with standby equipment to provide emergency dewatering in the event of failure of the primary method of groundwater control. Temporary observation wells must be installed at the site to confirm groundwater levels prior to excavation and monitor drawdown at the location of the adjacent 2.0-MG clearwell. To prevent possible costly construction delays, the required dewatering must be conducted well in advance of the excavation in order to lower and maintain groundwater levels at least 5 feet below the deepest excavation level at all times.

The dewatering system should be designed by the contractor, considering the effect of groundwater lowering on the adjacent 2.0-MG clearwell. It is likely that settlement of the existing clearwell will occur as a result of the mass dewatering required for the new clearwell. Groundwater recharge and/or positive cutoff measures may be necessary between the planned excavation and the existing clearwell to avoid lowering the groundwater underneath the structure. Water levels in observation wells adjacent to the existing clearwell and settlement of the structure should be monitored during construction to evaluate the effects of the dewatering and warn of possible distress to the structure.

Once the groundwater has been lowered to about elevation 1118 or lower, mass excavation of the new clearwell area may proceed. We recommend the mass excavation extend no deeper than 2 feet above the design subgrade elevation of 1125.5. Final excavation and stabilization of the subgrade

should then be performed in small, controlled areas. As small sections of the subgrade are exposed, each area should be inspected by the geotechnical engineer and then immediately protected by backfilling with a layer of crushed stone. Even with successful dewatering, we expect it will be necessary to undercut at least 2 feet of the subgrade soils and replace them with crushed stone. Equipment traffic on the prepared subgrade should be prohibited prior to placement of the Class C concrete.

Permanent Underdrains/Hydrostatic Pressure Relief. Structures constructed below the water table are subject to hydrostatic pressures, and provisions must be included in the design to protect grade slabs and below grade walls from the build-up of excessive uplift and lateral water pressures. Measures must also be included to reduce the likelihood of water seepage into structures, except when necessary to balance any excessive buoyant forces. Structures may be designed to either structurally resist any unbalanced water pressures or permanent underdrain systems and foundation drains must be provided. Pressure relief valves may also be installed within structures to prevent excessive buoyant pressures from occurring.

We understand that the new clearwell will be designed to provide sufficient uplift resistance by anchoring to the 3-foot thick concrete slab under the floor and by backfilling over the top. At the package plant location, a subdrainage system below the floor slab is not required. However, we recommend that a 4-inch layer of clean crushed stone or gravel covered with an impermeable membrane be placed beneath the building slab to provide a vapor barrier.

Difficult Excavation

Within the new clearwell area, partially weathered rock was encountered near the planned excavation level at the locations of borings B-1 and B-2. At the package plant location, layers of partially weathered rock were found within the residual soil stratum at depths of 3 feet in boring B-11 and 8 feet in B-12. Very dense or very hard soils were also encountered at various depths in a majority of the package plant borings. Based upon this information, we expect that some difficult excavation techniques during foundation and/or utility construction within the package plant area and possibly during mass site grading operations for the clearwell may be required for the removal of partially weathered rock, very dense or very hard soils, or possibly rock that could occur between our boring locations.

In mass excavations for general sitework, very hard or very dense soils and weathered rock can usually be removed by ripping with a single-tooth ripper attached to a large crawler tractor or by breaking the material out with a large front-end loader. In confined excavations, such as foundations and utility trenches, removal of weathered rock typically requires use of large backhoes, pneumatic spades, or light blasting. Refusal materials (apparent rock) usually require blasting for removal in both mass and confined excavations. Any blasting within structure subgrade areas or in footing excavations must be done carefully to prevent damage to the bearing materials.

The definition of rock can be a source of conflict during construction. The following definitions have been incorporated into specifications on other projects and are provided for your general guidance:

1. General Excavation

    - Rip Rock - Any material that cannot be removed by scrapers, loaders, pans, dozers, or graders; and requires the use of a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds.

    - Blast Rock - Any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent; and occupying an original volume of at least one (1) cubic yard.

2. Trench/Foundation Excavation

    - Blast Rock - Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,000 pounds and a stick crowd of not less than 29,000 pounds (Caterpillar 325 or equivalent), and occupying an original volume of at least one-half (½) cubic yard.

Earthwork

Based upon our qualitative evaluation of the subsurface conditions at the site and previous experience with similar soils, we expect the majority of the native soils and clean fill soils from the clearwell area will be suitable for use as structural fill. Soils from near or below the water table, are expected to be excessively wet and would require spreading and drying prior to fill placement. Typically, the wet soils are considered to be unsuitable for reuse. All structural fill should have a plasticity index (PI) less than 30 and be clean soil free of deleterious materials and rocks larger than 3 inches in diameter. The maximum dry density of structural fill soils should be at least 90 pcf, in order to provide adequate strength. All fill materials should be evaluated by the geotechnical engineer, and soil classification and compaction characteristics (moisture-density relationships) should be determined in the laboratory in advance of the earthwork.

General site structural fill required to achieve site grades underneath pavements, buildings, and treatment structures, or to replace undercut areas should be placed in maximum 6 to 8-inch lifts, loose measure, and compacted to at least 95 percent of the maximum dry density as determined by the standard Proctor compaction test (ASTM D-698). Backfill in trenches or other confined spaces, where light portable compaction equipment is required, should be placed in maximum lift thicknesses of 3 to 4 inches, loose measure. In landscaped areas, where no structures are planned or anticipated in the future, the compaction criteria may be reduced to 90 percent of the standard Proctor maximum dry density. We note that moisture control is important with the native soils typical of this area in order to achieve adequate compaction, and equipment should be available on site during construction for both wetting and drying proposed fill soils. Except for soils excavated from below the water table, we do not anticipate significant problems in controlling moisture contents during dry weather; however, during winter months or during extended wet periods, moisture control problems will likely occur.

During fill placement, a sufficient number of field density tests should be conducted by a qualified soils technician working under the direction of a geotechnical engineer to determine the degree of compaction and compliance with the project specifications. We recommend at least one density test be conducted per 2,500 - 5,000 square feet of fill area for each 2-foot interval of compacted soil. Any areas that do not comply with the compaction requirements during the earthwork construction should be recompacted until compliance is met.

Inspection

We recommend that all base slab subgrades and foundation excavations be evaluated by a qualified geotechnical engineer to confirm that conditions are similar to those encountered in the borings and that the bearing soils are capable of supporting the design contact pressures. Foundation excavations should be free of all soft or loose soil, mud, disturbed materials, and other deleterious materials prior to placement of concrete. In addition, concrete should not be placed on a frozen subgrade. Any foundation bearing surfaces that have been disturbed due to construction activities or exposure to precipitation or run-off must be repaired prior to placement of concrete. We recommend that foundation excavations and slab subgrades be concreted as soon as practical after they are excavated and that water not be allowed to pond or infiltrate the bearing surface. If it is necessary to leave the excavations open for an extended period of time, we recommend that a thin mat of lean concrete be placed over the bottom for protection.

QUALIFICATION OF RECOMMENDATIONS

This report has been prepared for the exclusive use of the City of Cumming and Civil Engineering Consultants, Inc. for design and construction of the proposed 6-MGD WTP expansion. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with those normally used in geotechnical engineering practice for projects of this type. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions. Allowable soil bearing capacity was estimated from previous correlations of standard penetration resistances and bearing capacities of comparable soils. Should the project plans change substantially from those outlined in this report, we request the opportunity to review our recommendations in light of the changes. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the changed conditions to formulate any required modifications to the recommendations presented herein.

APPENDIX A

FIELD AND LABORATORY PROCEDURES

GEOSYSTEMS ENGINEERING

STANDARD FIELD AND LABORATORY TESTING PROCEDURES

Soil Test Boring

Soil sampling and penetration testing are performed in general accordance with ASTM Designation D 1586. Borings are usually advanced either by mechanically twisting continuous steel hollow-stem auger flights into the ground or by wash boring using roller cone or Hawthorne bits. At regular intervals, soil samples are obtained with a standard 1.4-inch I.D., 2-inch O.D., split-spoon sampler. The sampler is first seated 6 inches into the bottom of the hole to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to achieve the final foot of penetration is recorded and is designated the "standard penetration resistance." Penetration resistance, when properly evaluated, is an index to the soil strength, density and ability to support foundations.

Groundwater levels are normally determined by the driller in conjunction with the field investigation and are noted on the drilling records. These levels indicate the approximate location of the hydrostatic water table at the time of observation. Generally, water levels are reported at the time of boring and at subsequent times. The time of boring water level is detected as the drilling tools are advanced by changes in the drilling rate, soil sample moisture conditions, water or mud on the drill rods, and moisture conditions of the borehole drill cuttings. Additional groundwater levels are typically obtained at various times after boring to minimize any disruption by the drilling operations and to allow the water table to stabilize. Normally, a time lag of at least 24 hours is required to permit stabilization of the water table. A longer time period may be required in low permeability (clayey) soils. Water table measurements are taken in open boreholes using a weighted measuring tape or electronic groundwater level indicator.

Representative portions of the soil samples, obtained from the split-spoon sampler, are sealed in containers and shipped or transported to the office. In the office, the samples are examined by an engineer to verify the driller's field classifications.

Auger Borings

Auger borings, wash borings, and air hammer drilling without standard penetration testing are practical when the depth to rock is of primary concern. Auger and wash borings may also be used to obtain undisturbed samples at pre-selected depths. The borings may be advanced by hollow-stem augers, wash boring techniques using roller cone or Hawthorne bits, or pneumatic hammer drills to termination or refusal depths. The soils and rock materials encountered are roughly identified by the driller from cuttings brought to the surface during the drilling process. Crude estimates of the soil consistency or relative density and rock quality may also be made from the difficulty of the drilling process in advancing the borehole.

Undisturbed Sampling

Split tube samples are suitable for visual examination and classification tests but are not sufficiently intact for quantitative laboratory testing. Relatively undisturbed samples are obtained by pushing sections of 3 inch O.D., 16-gauge, steel "Shelby" tubing into the soil at the desired sampling levels. This procedure is described by ASTM Standard D-1587. Each tube, together with the encased soil, is carefully removed from the ground, made airtight, and transported to the laboratory. Locations and depths of undisturbed samples are shown on the Test Pit or Boring Records.

Soil Identification and Description

Soils are normally classified using the Unified Soil Classification System (ASTM D 2487). This is useful for grouping them for a particular purpose, but may be misleading in other applications. In addition to standard classification, soils are identified in accordance with the important soil properties to provide a complete description and assist with predicting behavior. Soil properties significant to most earthwork/foundation problems include consistency (cohesive fine grained soils) or relative density (cohesionless granular soils), color, and texture or composition. Consistency and relative density are fundamental properties in evaluating soil strength and are typically estimated based on standard penetration test results. The engineer's examination of soil samples recovered during the field investigation is primarily a qualitative visual process. Detailed soil classification requires basic laboratory grain size analyses and Atterberg limits (plasticity) tests.

Grain Size/Gradation

Grain size tests are performed to determine the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D-421 (dry preparation) or ASTM D-2217 (wet preparation). The grain size distribution of soils coarser than a number 200 sieve (0.074 mm opening) is determined by passing the samples through a standard set of nested sieves. A sample of known weight is passed through the sequence of sieves with decreasing size of openings and the portions retained on each sieve weighed. Materials passing the number 200 sieve are suspended in water and the grain size distributing calculated from the measured settlement rate (hydrometer analysis). Hydrometer analysis determines the density of a suspension of soil at various times after agitation. Using Stokes's law, the particle size remaining suspended at each particular time is calculated and the corresponding density is a measure of the quantity of soil smaller than the computed size. Procedures for the grain size analysis of soils is described by ASTM D-422.

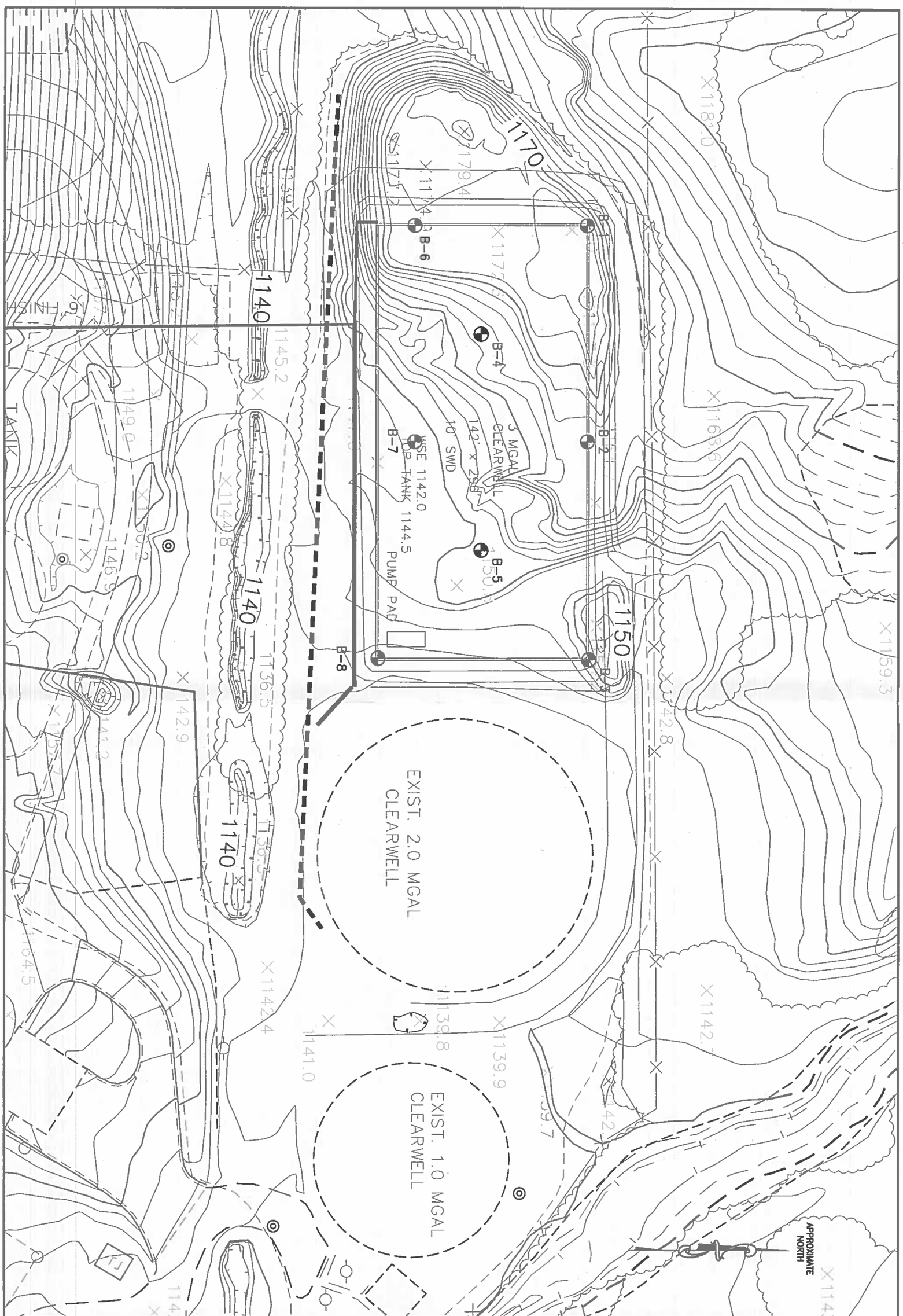
Permeability/Hydraulic Conductivity

The permeability test is used to measure the ease with which water will flow through the soil, such as seepage under dams, percolation from land application, the squeezing out of water from the soil by the application of load, and drainage of subgrades, dams and backfills.

Hydraulic conductivity testing by the flexible wall permeameter method is performed on undisturbed or remolded samples according to ASTM D 5084. Constant head (Method A), falling head (Methods B & C), or constant rate of flow (Method D) systems may be utilized. Generally, the constant head method is used for granular soils and the falling head method for fine grained soils. Once the samples are prepared, each test specimen is trimmed, porous plates are placed on the ends, and encased in a rubber membrane. The encased test specimens are placed in permeameter cells and saturated, usually with back pressure. After saturation, a differential pressure head of water is applied across the sample and changes in pressure head with time are measured and recorded. Permeability or hydraulic conductivity of each soil sample is calculated from the test data.

APPENDIX B

FIGURE 1 – BORING LOCATION PLAN
FIGURE 2 – BORING LOCATION PLAN
FIGURE 3 – BORING LOCATION PLAN
KEY TO SYMBOLS AND CLASSIFICATIONS
BORING LOGS – 24 PAGES



LEGEND

⊕ – SOIL TEST BORING

0 30 60
GRAPHIC SCALE (FEET)

SCALE: 1" = 60' (APPROXIMATELY)

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

BORING LOCATION PLAN

PROJECT: CITY OF CUMMING WTP EXPANSION
Clearwell, Package Plant, and Pump Stations
Cumming, Forsyth County, Georgia
GeoSystems Project Number: 06-1899

PREPARED BY: ARC	
DATE: 10/13/2006	
REVIEWED BY: LDM	
DATE: 10/13/2006	

FIGURE: 1

BORING LOCATION PLAN

PROJECT: CITY OF CUMMING WTP EXPANSION
Clearwell, Package Plant, and Pump Stations
Cumming, Forsyth County, Georgia
GeoSystems Project Number: 06-1899

PREPARED BY: ARC
DATE: 10/13/2006
REVIEWED BY: LDM
DATE: 10/13/2006

FIGURE: 2

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

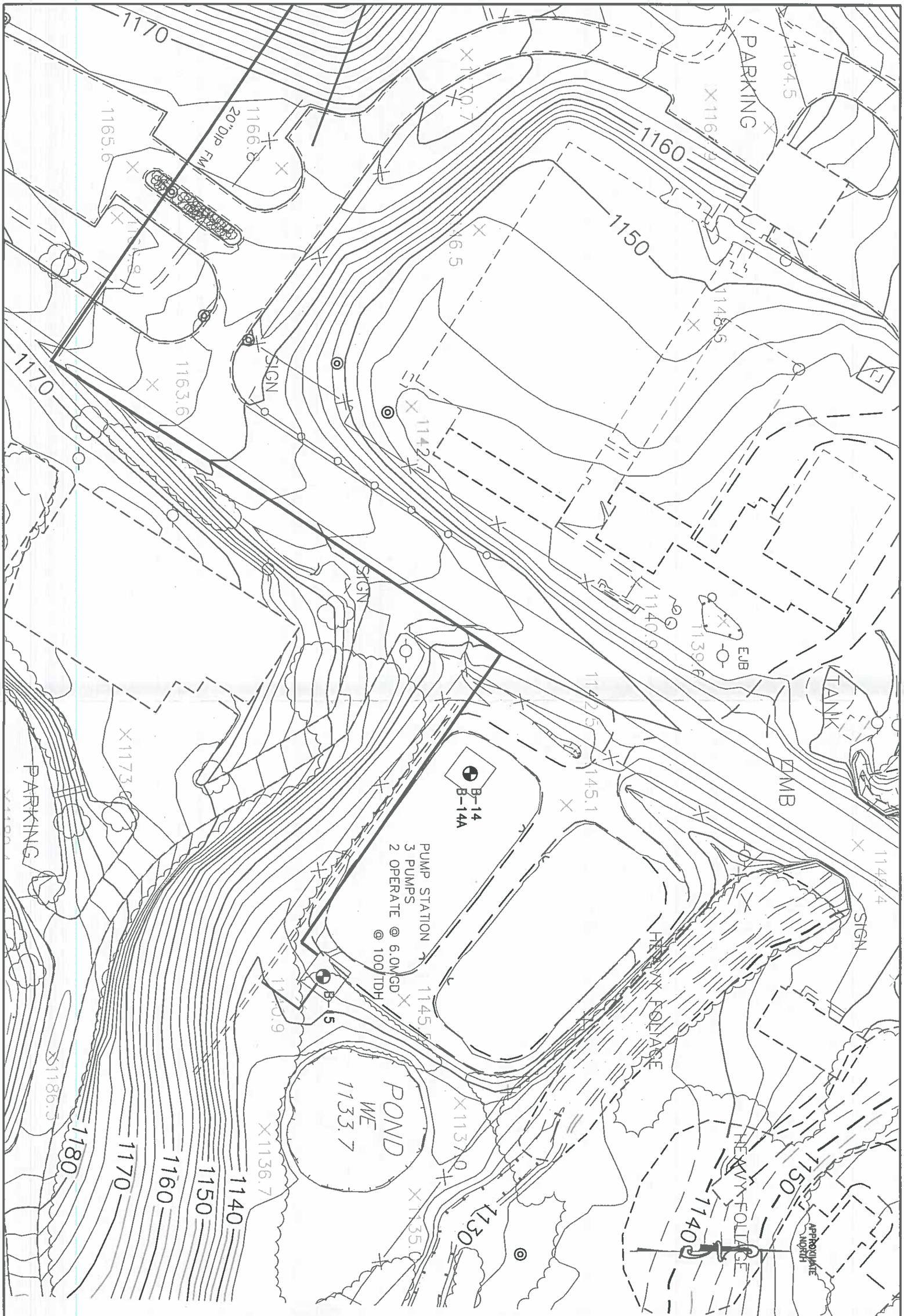
LEGEND
⊕ - SOIL TEST BORING

GRAPHIC SCALE (FEET) 0 30 60

SCALE: 1" = 60' (APPROXMATELY)

APPROXIMATE NORTH

HEAVY FOLIAGE
1160
1170
1180
1190
1200
1210
1220
1240
TANK
TANK
FINISHED WATER
RAW WATER SERVICE
SIGN
SIGN
SIGN
B-10
B-13
B-11
B-12
B-9
F.F.E. 1206.0
6.0 MGD PACKAGE PLANT
19.67' 83'x 140'
27.17'
LOADING DOCK 1202.0
LIME
COLUMN (TYP.)
BASEBALL FIELD
BASEBALL FIELD
BASEBALL FIELD
CHAIN LINK FENCE
×1209.5
×1203.2
×1204.2
×1204.7
×1205.9
×1174.2
×1161.6
×1164.5
1200
1190
1180
1170



LEGEND

⊕ – SOIL TEST BORING

0 30 60
GRAPHIC SCALE (FEET)

SCALE: 1" = 60' (APPROXIMATELY)

GEOSYSTEMS
ENGINEERING, INC.

REFERENCE: 06-1899 City of Cumming WTP Expansion PLAN

BORING LOCATION PLAN

PROJECT: CITY OF CUMMING WTP EXPANSION
Clearwell, Package Plant, and Pump Stations
Cumming, Forsyth County, Georgia
GeoSystems Project Number: 06-1899

PREPARED BY: ARC	
DATE: 10/13/2006	
REVIEWED BY: LDM	
DATE: 10/13/2006	

FIGURE: 3

KEY TO SYMBOLS AND CLASSIFICATIONS


FILL


TOPSOIL


PAVEMENT


PARTIALLY WEATHERED ROCK


CL: Low plasticity inorganic clays


CH: High plasticity inorganic clays


ML: Low plasticity inorganic silts


MH: High plasticity inorganic silts


SP: Poorly graded sands


SW: Well graded sands


GP: Poorly graded gravels


GW: Well graded gravels


OL: Low plasticity organic silts and clays


OH: High plasticity organic silts and clay


SM: Silty sands


GM: Silty gravels


SC: Clayey sands


GC: Clayey gravels

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	N - VALUE BLOWS PER FOOT	APPROXIMATE RELATIVE DENSITY
SANDS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
		APPROXIMATE CONSISTENCY
SILTS AND CLAYS	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
	OVER 50	Very Hard

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1

GEOLOGIST: *N/A*
ELEVATION: *1162 Feet*
DATE DRILLED: *10/16/06*
BORING DEPTH: *53 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *23 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 41 Feet. The 24 hour water level (▽) was measured at 23 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Medium dense orange brown micaceous silty SAND (SM) with some gravel		11
5			1157.0	
		Loose dark brown organic silty fine SAND (SM)		7
10			1152.0	
		Stiff brown micaceous SILT (ML)		12
15			1147.0	
		Residuum – Medium dense orange brown micaceous silty fine SAND (SM)		12
20		▽	1142.0	
				14
25			1137.0	
		Stiff orange brown micaceous sandy SILT (ML)		29
30			1132.0	
				27
35			1127.0	
		Partially Weathered Rock – Sampled as very dense grey micaceous silty SAND (SM)		50/3"
40			1122.0	

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100

Job No. 06-1899

GEOSYSTEMS ENGINEERING, INC.

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-1

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
45		**Partially Weathered Rock** – Sampled as very hard grey brown sandy SILT (ML)	1117.0	50/5"	
50			1112.0	50/4"	
		Auger Refusal at 53 Feet			
55			1107.0		
60			1102.0		
65			1097.0		
70			1092.0		
75			1087.0		
80			1082.0		
85			1077.0		

GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

GEOLOGIST: *N/A*	ELEVATION: *1162 Feet*
DATE DRILLED: *10/20/06*	BORING DEPTH: *43 Feet*
DRILLER: *GABLE DRILLING CO.*	WATER LEVEL: *25 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*	

NOTES: Water level at time of boring (▽) was measured at 25 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Very stiff orange red tan micaceous clayey SILT (MH)		
5			1157.0	19
		Stiff orange red fine sandy SILT (ML)		
10			1152.0	11
		Firm light brown micaceous fine sandy SILT (ML)		
15			1147.0	6
		Residuum – Firm tan brown very micaceous fine sandy SILT (ML)		
20			1142.0	8
25		▽	1137.0	6
		Loose brown white very micaceous silty SAND (SM)		
30			1132.0	10
		Medium dense dark brown very micaceous silty fine SAND (SM)		
35			1127.0	16
		Partially Weathered Rock – Sampled as very dense white brown silty SAND (SM)		
40			1122.0	50/3"

STANDARD PENETRATION RESISTANCE (blows/ft)

1 10 100

GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-2

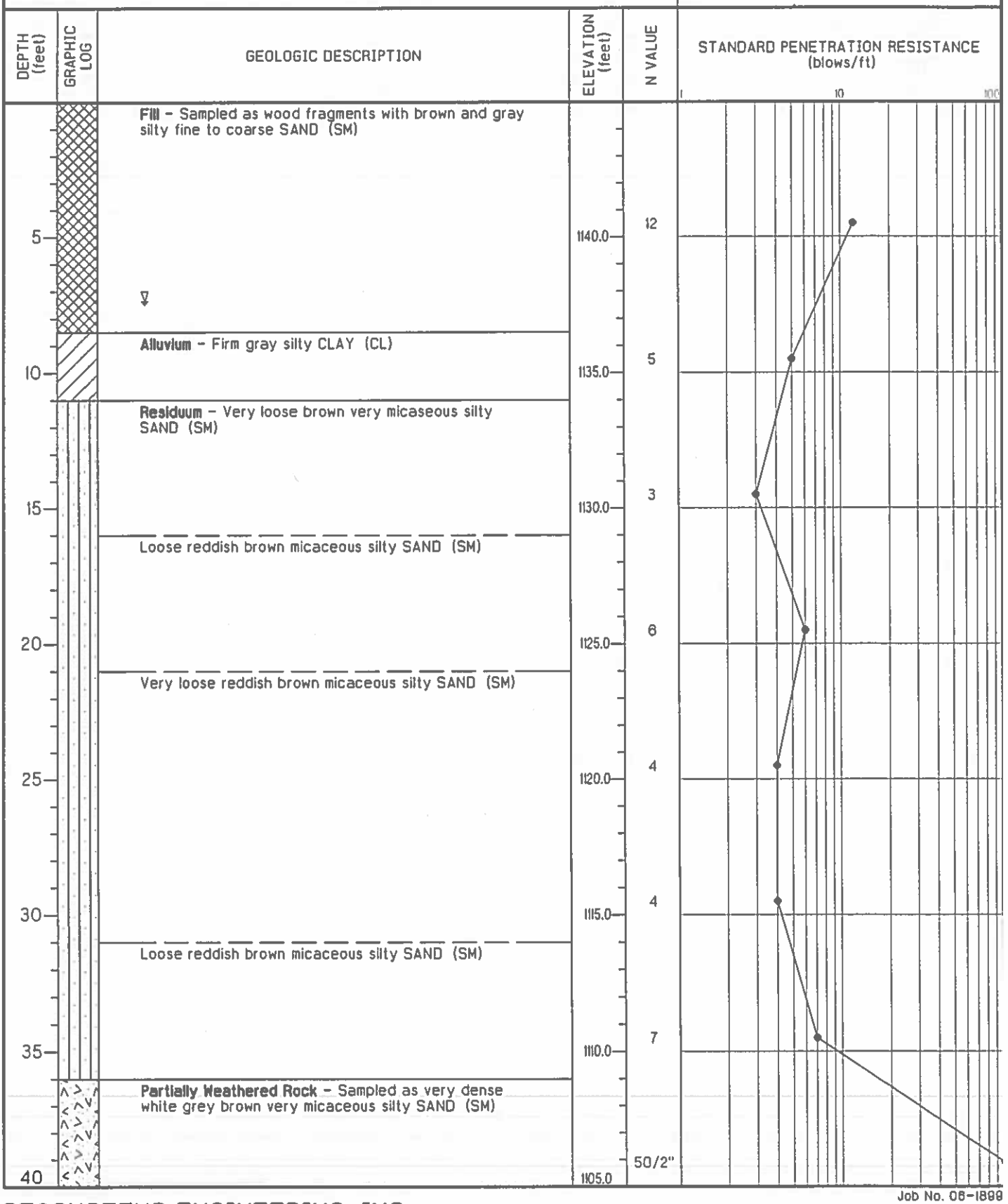
DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
		Partially Weathered Rock – Samples as very dense white brown silty SAND (SM)			
		Auger Refusal at 43 Feet			
45			1117.0		
50			1112.0		
55			1107.0		
60			1102.0		
65			1097.0		
70			1092.0		
75			1087.0		
80			1082.0		
85			1077.0		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3

GEOLOGIST: *N/A*
ELEVATION: *1145 Feet*
DATE DRILLED: *10/18/06*
BORING DEPTH: *42 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *7 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 7 Feet.



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-3

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
		Partially Weathered Rock- Sampled as very dense white grey brown very micaceous silty SAND (SM)			
		Augar Refusal at 42 Feet			
45			1100.0		
50			1095.0		
55			1090.0		
60			1085.0		
65			1080.0		
70			1075.0		
75			1070.0		
80			1065.0		
85			1060.0		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

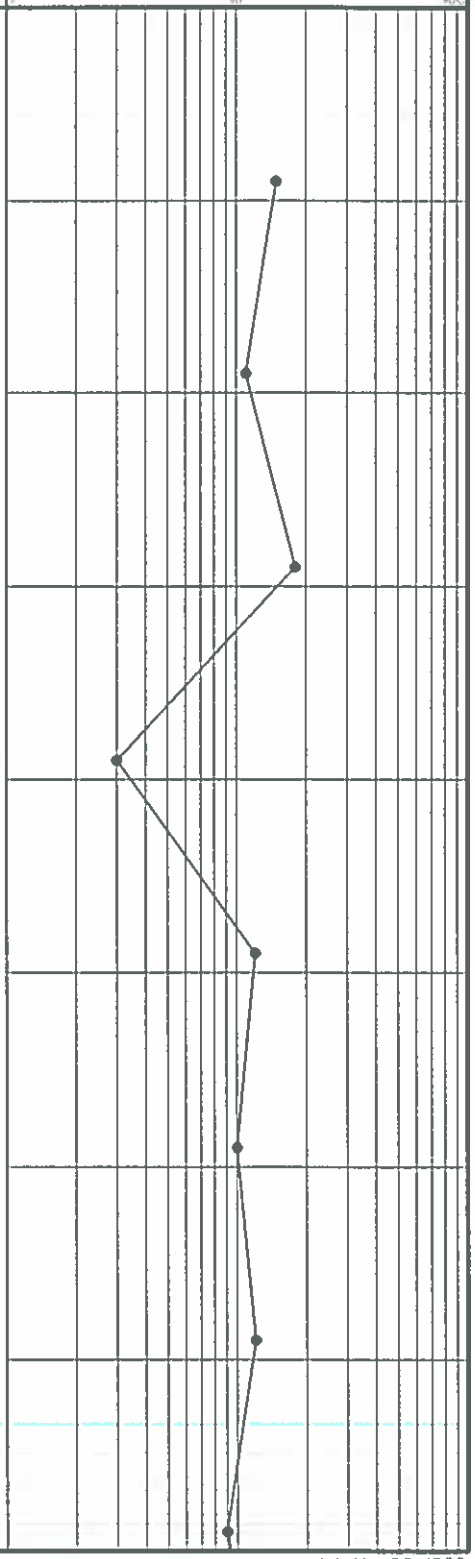
LOG OF BORING B-4

GEOLOGIST: *N/A*
ELEVATION: *1162 Feet*
DATE DRILLED: *10/19/06*
BORING DEPTH: *53 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *23 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 30 Feet. The 24 hour water level (▽) was measured at 23 Feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0	**Fill** – Medium dense grey brown fine to coarse SAND (SW) with some rock fragments		
5		1157.0	15
	Medium dense red orange fine to coarse SAND (SW)		
10		1152.0	11
	Medium dense orange grey fine to coarse SAND (SW)		
15		1147.0	18
	Soft brown orange CLAY (CH) with some organics		
20		1142.0	3
	Residuum – Medium dense to loose tan brown micaceous silty SAND (SM) with rock fragments (No sample recovered at 25 feet)		
25	▽	1137.0	12
30	▽	1132.0	10
35		1127.0	12
40		1122.0	9

STANDARD PENETRATION RESISTANCE (blows/ft)



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-4

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
		Medium dense to loose tan brown micaceous silty SAND (SM) with rock fragments		
45		Medium dense brown to grey brown silty SAND (SM)	1117.0	12
50			1112.0	14
		Auger Refusal at 53 Feet		
55			1107.0	
60			1102.0	
65			1097.0	
70			1092.0	
75			1087.0	
80			1082.0	
85			1077.0	

STANDARD PENETRATION RESISTANCE (blows/ft)

1 10 100



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

GEOLOGIST: *N/A*
ELEVATION: *1161 Feet*
DATE DRILLED: *10/16/06*
BORING DEPTH: *50 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *23 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 23 Feet. The 24 hour water level (▼) was measured at 23 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Medium dense tan brown silty SAND (SM)		
5			1156.0	15
		Loose tan brown silty SAND (SM)		
10			1151.0	8
		Firm grey brown CLAY (CL) with organics		
15			1146.0	7
		Residuum – Very loose grey white tan silty fine to coarse SAND (SM) (No sample recovered at 25 feet)	1141.0	4
20		▽ ▼		
25			1136.0	3
		Firm brown tan very micaceous sandy SILT (ML)	1131.0	5
30				
		Medium dense brown tan very micaceous silty SAND (SM)	1126.0	12
35				
40			1121.0	11

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100

GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-5

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
45		Medium dense brown tan very micaceous silty SAND (SM)	1116.0	16	
50			1111.0	16	
		Boring Terminated at 50 Feet			
55			1106.0		
60			1101.0		
65			1096.0		
70			1091.0		
75			1086.0		
80			1081.0		
85			1076.0		

GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-6

GEOLOGIST: *N/A*
ELEVATION: *1163 Feet*
DATE DRILLED: *10/16/06*
BORING DEPTH: *63 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *23 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 27 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** - Medium dense red brown silty SAND (SM)		
5			1158.0	11
		Loose reddish brown silty SAND (SM)		
10			1153.0	10
		Very loose brown silty SAND (SM)		
15			1148.0	4
		Loose greyish brown silty SAND (SM)		
20			1143.0	5
		Loose orange and red silty SAND (SM) (Wet)		
		▽		
25			1138.0	8
		Residuum - Firm greyish brown very micaceous sandy SILT (ML)		
		▽		
30			1133.0	7
35			1128.0	6
		Stiff grey brown very micaceous sandy SILT (ML)		
40			1123.0	10

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100

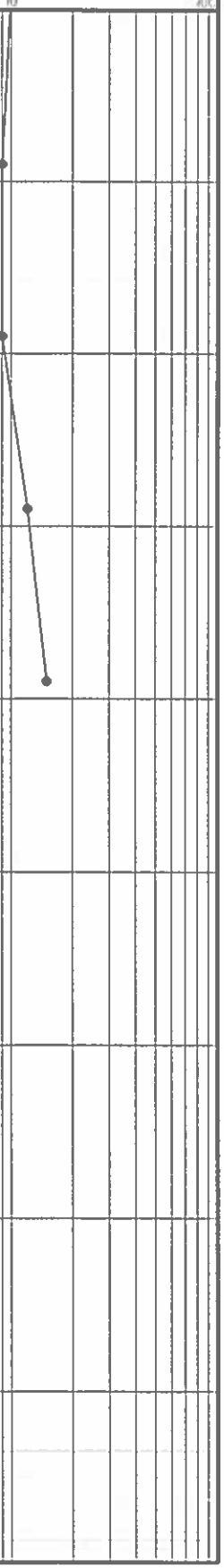
GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-6

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
45		Stiff grey brown very micaceous sandy SILT (ML)	1118.0	9	
50			1113.0	9	
55			1108.0	12	
60			1103.0	15	
		Auger Refusal at 63 Feet			
65			1098.0		
70			1093.0		
75			1088.0		
80			1083.0		
85			1078.0		



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

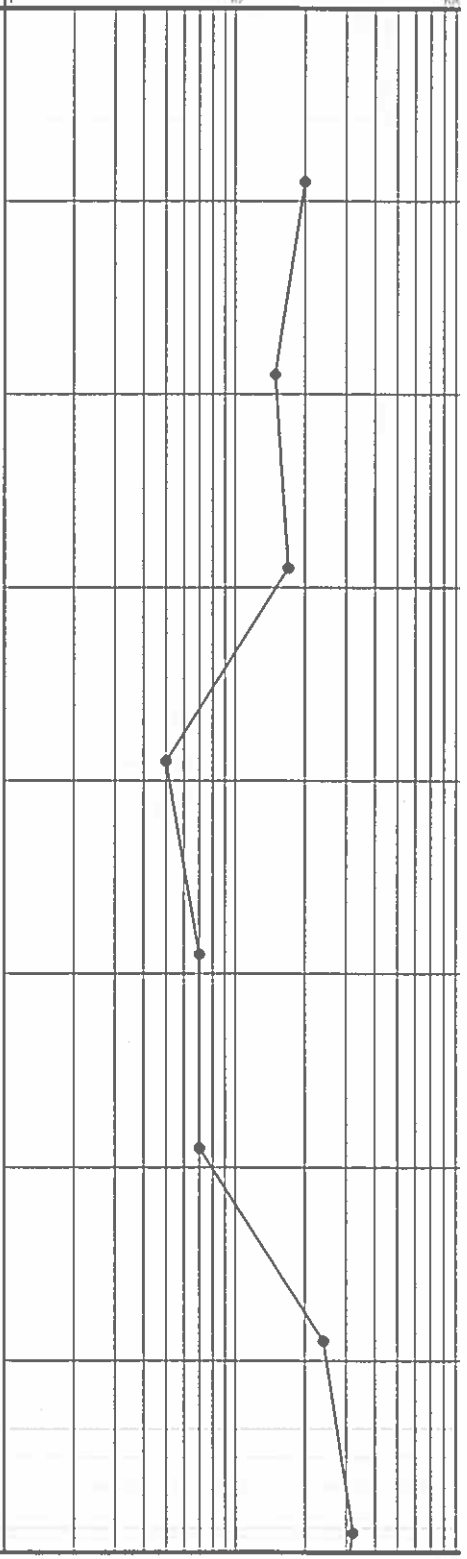
LOG OF BORING B-7

GEOLOGIST: *N/A*
ELEVATION: *1161 Feet*
DATE DRILLED: *10/19/06*
BORING DEPTH: *50 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *23 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 24 Feet. The 24 hour ground water level (▽) was measured at 23 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Medium dense brown silty SAND (SM)		
5			1156.0	20
10			1151.0	15
15			1146.0	17
20		Firm red brown sandy CLAY (CL)	1141.0	5
25		**Residuum** – Loose white yellow tan silty SAND (SM)	1136.0	7
30		Medium dense grey and white silty SAND (SM)	1131.0	7
35			1126.0	24
40		Dense greyish brown and yellow silty SAND (SM)	1121.0	32

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100



Job No. 06-1899

GEOSYSTEMS ENGINEERING, INC.

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-7

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
45		Dense greyish brown and yellow silty SAND (SM)	1116.0	22	
		Medium dense orange and dark brown silty SAND (SM)			
50		Boring Terminated at 50 Feet	1111.0	28	
55			1106.0		
60			1101.0		
65			1096.0		
70			1091.0		
75			1086.0		
80			1081.0		
85			1076.0		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8

GEOLOGIST: *N/A*
ELEVATION: *1142 Feet*
DATE DRILLED: *10/18/06*
BORING DEPTH: *45 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *5 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 5 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Soft brown silty CLAY (CH) with organics		
5		▽	1137.0	3
		Possible Alluvium – No sample recovered		
10			1132.0	2
		Residuum – Soft grey and white micaceous sandy SILT (ML)		
15			1127.0	2
20			1122.0	2
		Very stiff grey and white sandy SILT (ML)		
25			1117.0	16
30			1112.0	18
		Very stiff reddish brown very micaceous sandy SILT (ML)		
35			1107.0	21
40			1102.0	27

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100

Job No. 08-1899

GEOSYSTEMS ENGINEERING, INC.

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-8

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
		Very stiff reddish brown very micaceous sandy SILT (ML)			
		Partially Weathered Rock – Sampled as very dense dark brown micaceous silty fine SAND (SM)		50/4"	
45		Boring Terminated at 45 Feet	1097.0		
50			1092.0		
55			1087.0		
60			1082.0		
65			1077.0		
70			1072.0		
75			1067.0		
80			1062.0		
85			1057.0		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

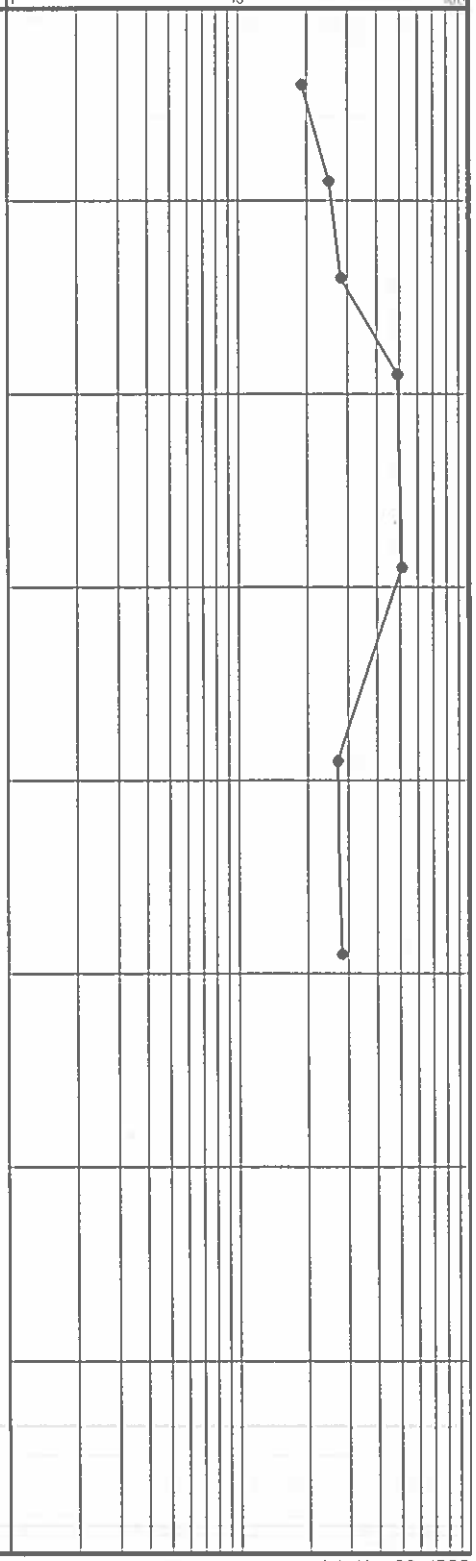
LOG OF BORING B-9

GEOLOGIST: *N/A*
ELEVATION: *1206 Feet*
DATE DRILLED: *10/20/06*
BORING DEPTH: *25 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *NGW@TOB **
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES:* – No ground water encountered at time of boring.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Residuum** – Medium dense light brown slightly micaceous silty fine SAND (SM)		19
5			1201.0	25
				28
		Dense light tan brown micaceous silty fine SAND (SM)		49
10			1196.0	
		Very dense light orange brown micaceous silty fine SAND (SM)		51
15			1191.0	
		Very stiff light brown micaceous fine sandy SILT (ML)		27
20			1186.0	
				28
25		Boring Terminated at 25 Feet	1181.0	
30			1176.0	
35			1171.0	
40			1166.0	

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

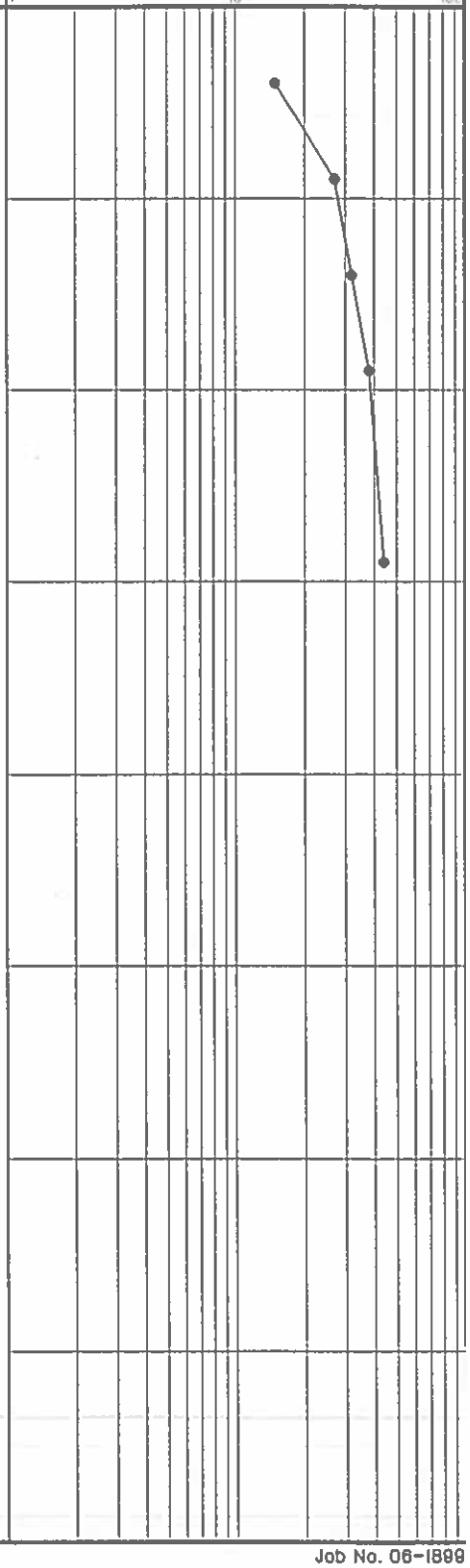
LOG OF BORING B-10

GEOLOGIST: *N/A*
ELEVATION: *1205 Feet*
DATE DRILLED: *10/20/06*
BORING DEPTH: *15 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *NGW@TOB **
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: * – No ground water encountered at time of boring.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Residuum** – Stiff to very stiff brown and white sandy SILT (ML)		15
5			1200.0	27
		Dense tan and white silty SAND (SM)		32
		Dense greyish tan fine to coarse SAND (SW) with rock fragments		38
10			1195.0	
15		Boring Terminated at 15 Feet	1190.0	44
20			1185.0	
25			1180.0	
30			1175.0	
35			1170.0	
40			1165.0	

STANDARD PENETRATION RESISTANCE (blows/ft)



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1898

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

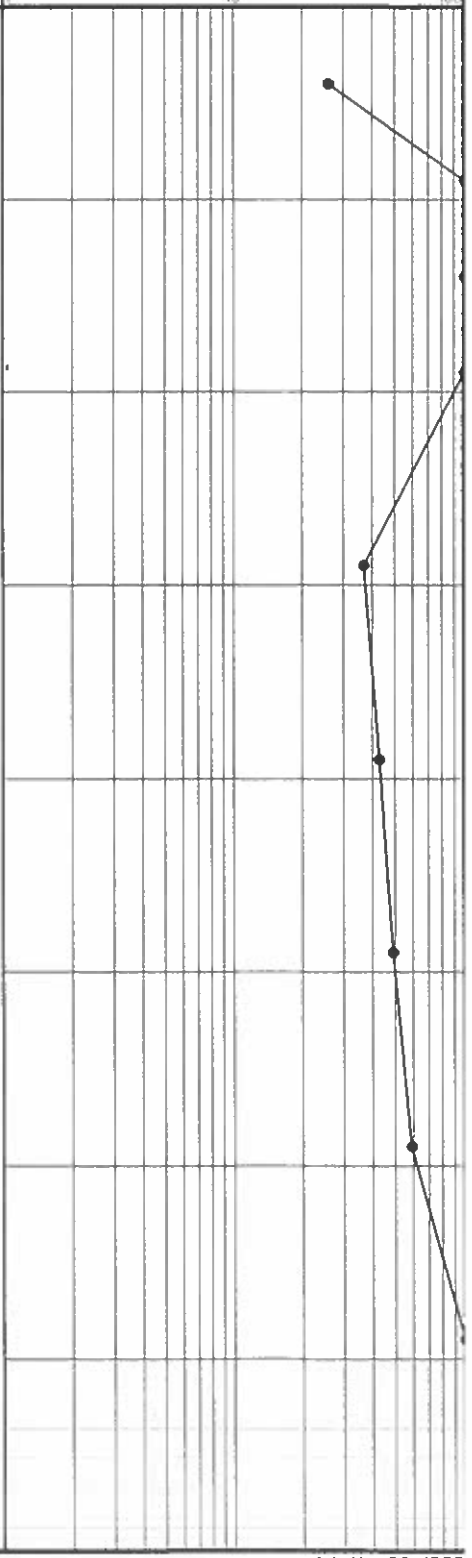
LOG OF BORING B-11

GEOLOGIST: *N/A*
ELEVATION: *1206 Feet*
DATE DRILLED: *10/20/06*
BORING DEPTH: *37 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *NGW@TOB **
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: * – No ground water encountered at the time of boring.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0	**Residuum** – Medium dense grey white tan silty SAND (SM)		26
5	**Partially Weathered Rock** – Sampled as very hard white orange brown sandy SILT (ML)	1201.0	50/5"
			50/4"
10		1196.0	31–50/3"
	Hard greyish brown and tan very micaceous sandy SILT (ML)		
15		1191.0	37
20		1186.0	43
25		1181.0	49
	Very hard white and brown very micaceous sandy SILT (ML)		
30		1176.0	59
	Partially Weathered Rock – Sampled as very hard white tan and brown sandy SILT (ML)		
35		1171.0	50/2"
	Augar Refusal at 37 Feet		
40		1166.0	

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

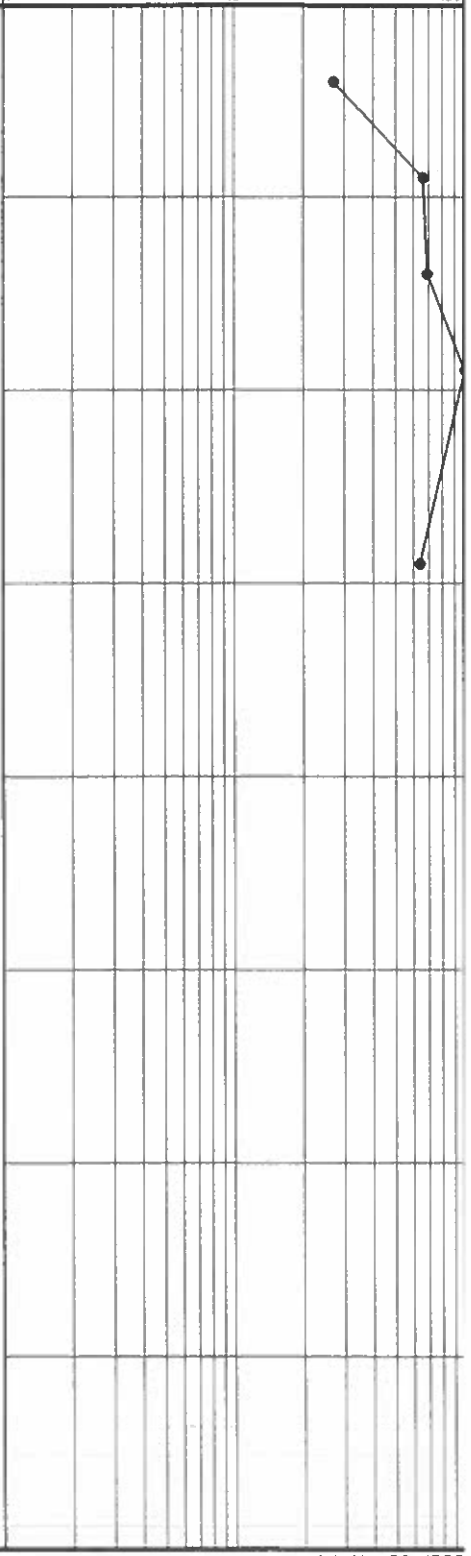
LOG OF BORING B-12

GEOLOGIST: *N/A*	ELEVATION: *1206 Feet*
DATE DRILLED: *10/20/06*	BORING DEPTH: *15 Feet*
DRILLER: *GABLE DRILLING CO.*	WATER LEVEL: *NGW@TOB **
DRILLING METHOD: *HOLLOW STEM AUGER*	

NOTES: No ground water encountered at time of boring.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Residuum** – Very stiff tan brown sandy SILT (ML)		27
		Very hard greyish tan sandy SILT (ML)		66
5			1201.0	69
		Partially Weathered Rock – Sampled as very dense grayish tan brown silty SAND (SM)		50/4"
10			1196.0	
		Very dense greyish brown and white silty SAND (SM)		64
15		Boring Terminated at 15 Feet	1191.0	
20			1186.0	
25			1181.0	
30			1176.0	
35			1171.0	
40			1166.0	

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

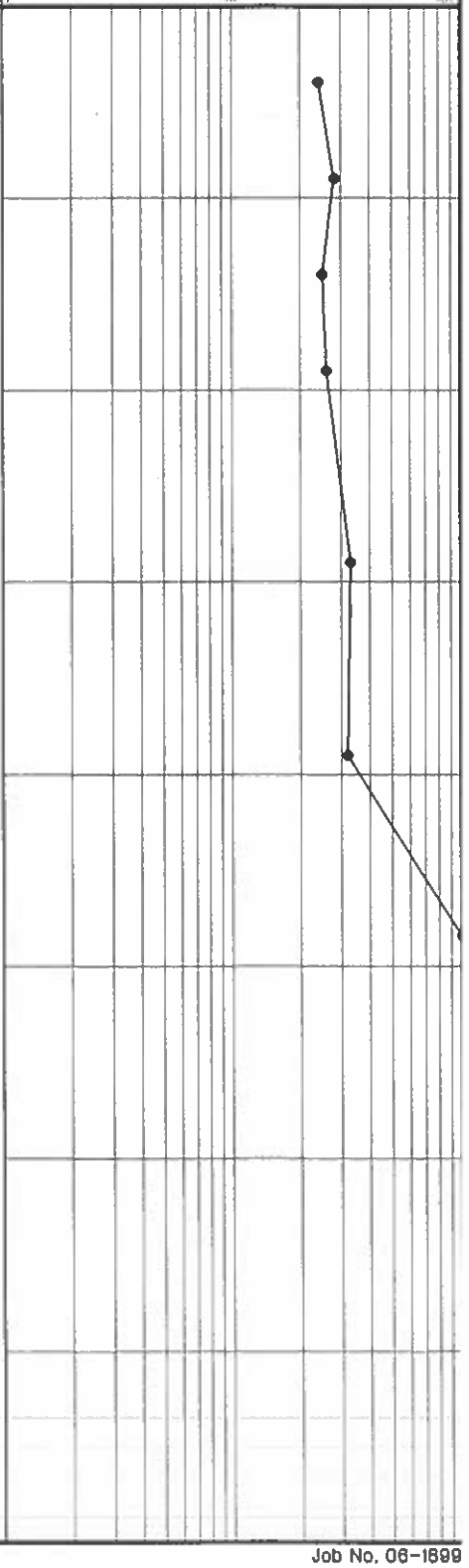
LOG OF BORING B-13

GEOLOGIST: *N/A*
ELEVATION: *1204 Feet*
DATE DRILLED: *10/20/06*
BORING DEPTH: *25 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *NGW@TOB **
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: No ground water encountered at time of boring.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Residuum** –Medium dense tan brown and white micaceous silty SAND (SM)		24
5			1199.0	28
				25
10			1194.0	26
				33
15			1189.0	
		Medium dense tan brown and white micaceous silty SAND (SM) with gravel		
20			1184.0	32
		Very dense orange brown and white silty SAND (SM)		
25			1179.0	50/5"
		Boring Terminated at 25 Feet		
30			1174.0	
35			1169.0	
40			1164.0	

STANDARD PENETRATION RESISTANCE (blows/ft)
1 10 100



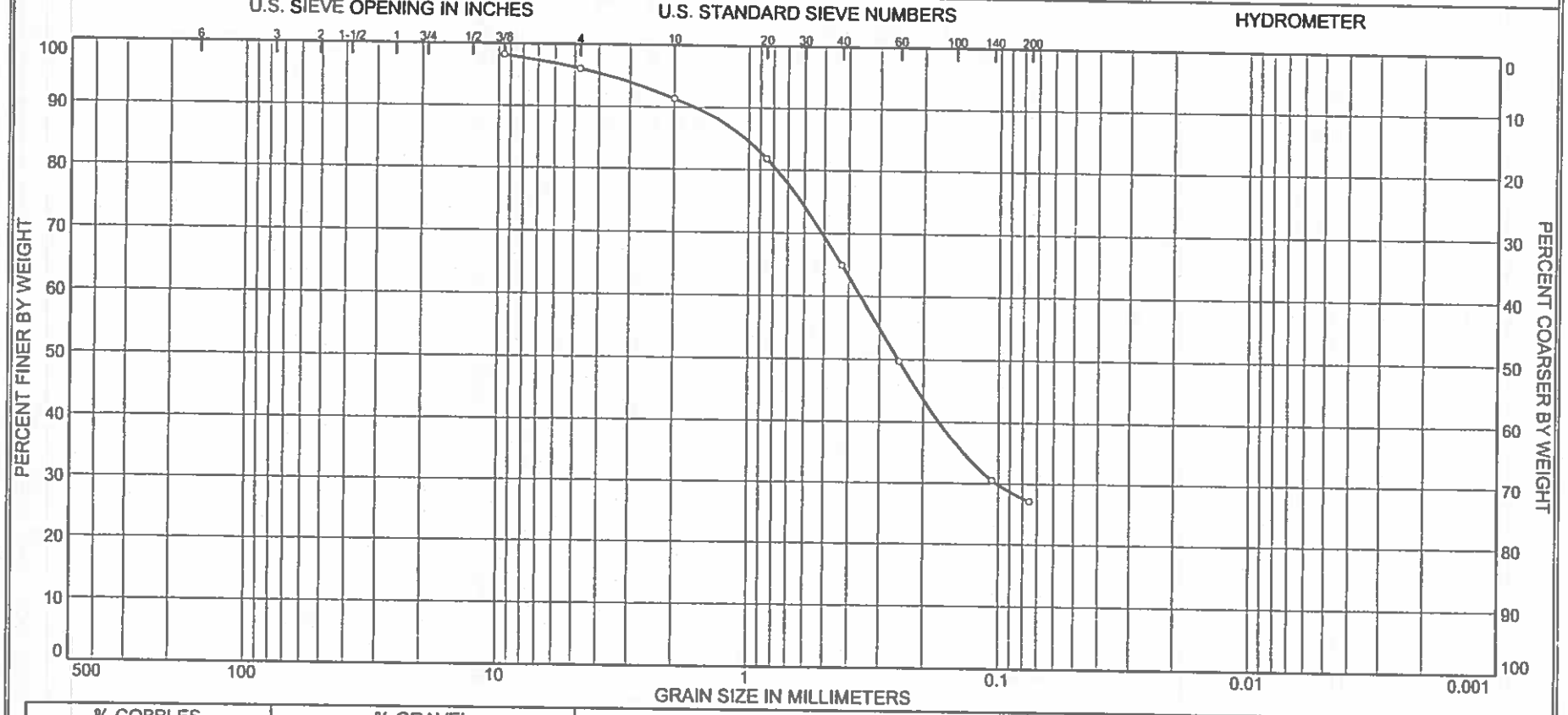
GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1699

APPENDIX C

LABORATORY TEST REPORTS

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
		69.0	27.1	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	5	25'	10/27/06	SM	Orange and Green Micaceous Silty sand	21.8		

Client Geosystems Engineering

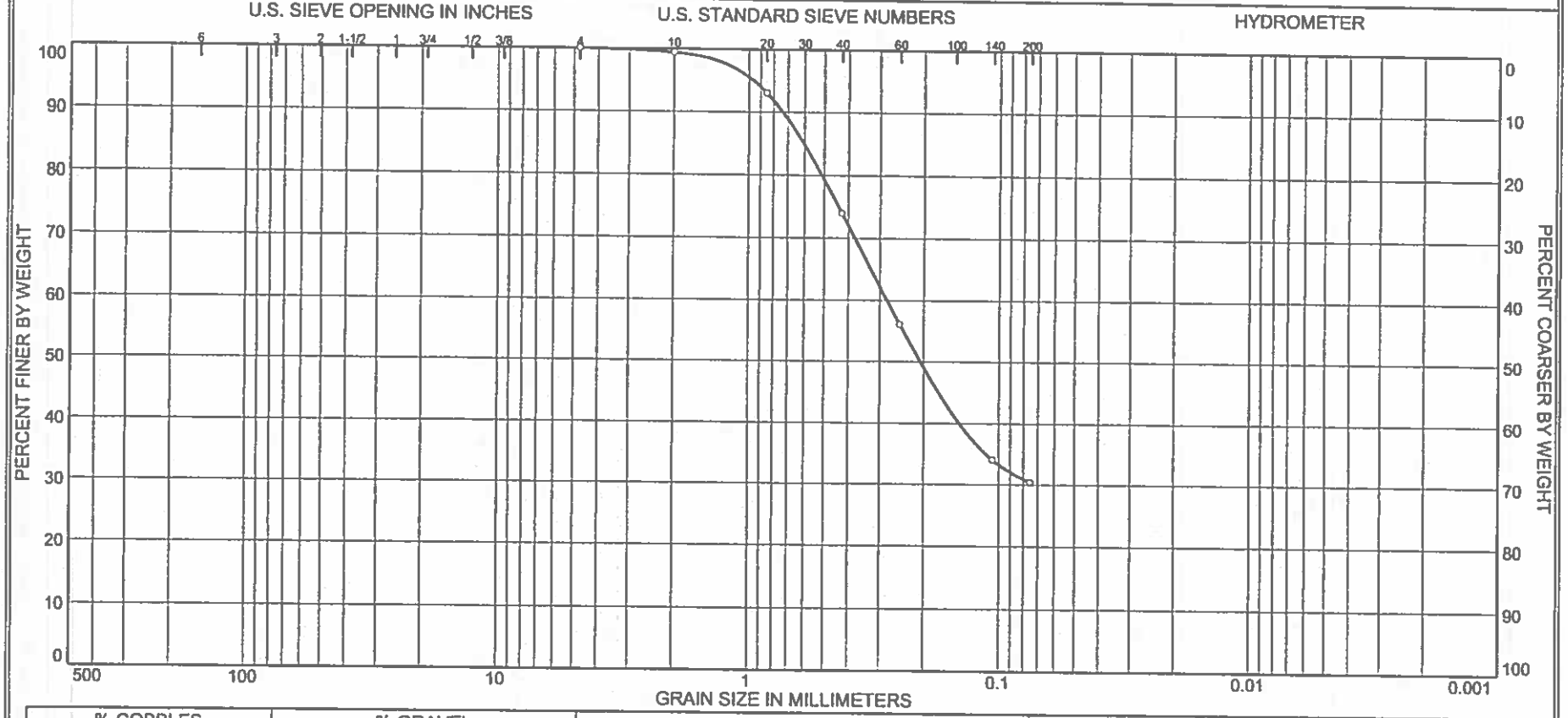
Project City of Cumming WTP Expansion

Project No. GTX-G1151 Lab no.

GeoTesting Express Inc.

Tested By: CNA
Reviewed By: JW

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	69.6	30.4	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-1	7	35'	10/27/06	SM	Black and White Micaceous Silty sand	18.8		

Client Geosystems Engineering

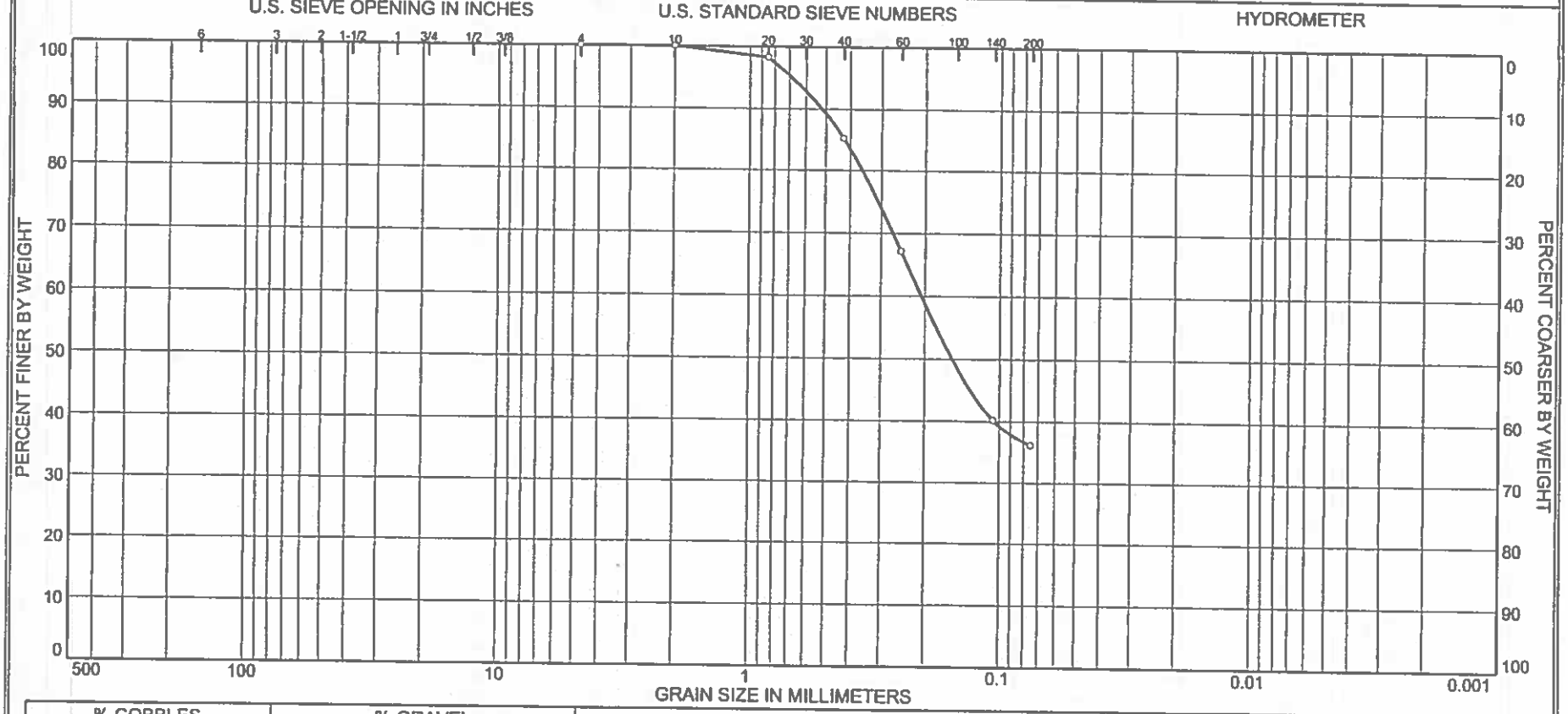
Project City of Cumming WTP Expansion

Project No. GTX-G1151 Lab no.

GeoTesting Express Inc.

Tested By: CNA
Reviewed By: JW

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	63.9	36.1	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-4	UDS	42-44'	10/27/06	SM	Brown and White Micaceous Silty sand	31.6		

Client Geosystems Engineering

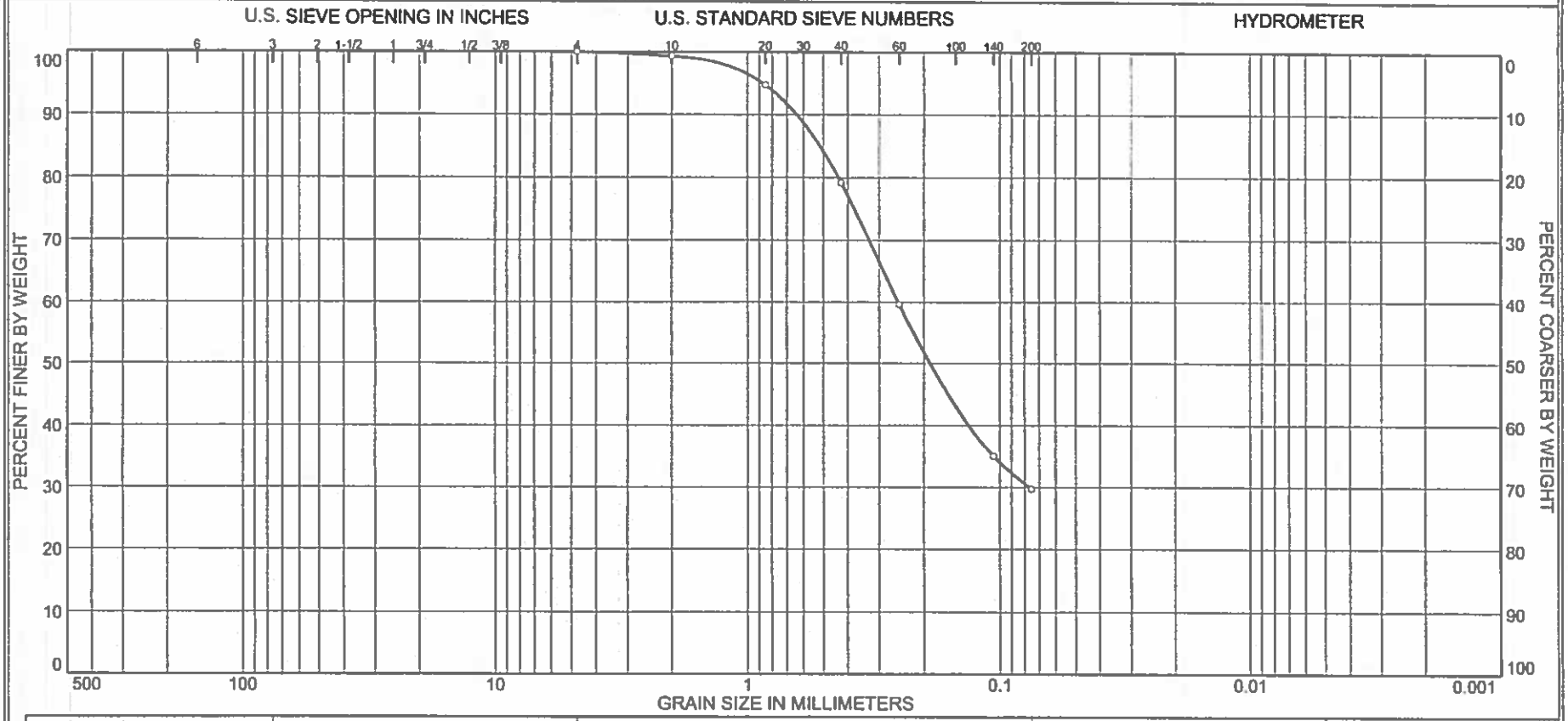
Project City of Cumming WTP Expansion

Project No. GTX-G1151 Lab no.

GeoTesting Express Inc.

Tested By: CNA
Reviewed By: JW

Particle Size Distribution Report ASTM D422/ASTM D1140



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY
0.0	0.0	70.3	29.7	

SOURCE	SAMPLE #	DEPTH/ELEV.	DATE SAMPLED	USCS	MATERIAL DESCRIPTION	NM %	LL	PL
B-5	UDs	42-44'	10/27/06	SM	Brown Micaceous Silty sand	45.0		

Client Geosystems Engineering

Project City of Cumming WTP Expansion

Project No. GTX-G1151 Lab no.

GeoTesting Express Inc.

Tested By: CNA
Reviewed By: JW

GeoTesting express

HYDRAULIC CONDUCTIVITY

Project No.	*GTX-G1151*	Tested By	*JW*
Project Name	*City of Cumming WTP Expansion*	Test Date	*10/26/2006*
Boring No.	*B-4*	Reviewed By	*CA*
Sample No.	*UDS*	Review Date	*10/30/2006*
Sample Depth	*42-44 ft*	Lab No.	*20835*

Sample Description ***Brown and white micaceous silty sand***

ASTM D5084 - Falling Head (Method C RisingTail)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*34.5*
Wet Unit Weight, pcf:	*111.1*
Dry Unit Weight, pcf:	*82.6*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***5.6E-05***

Remarks: _____

GeoTesting express

HYDRAULIC CONDUCTIVITY

Project No.	*GTX-G1151*	Tested By	*JW*
Project Name	*City of Cumming WTP Expansion*	Test Date	*10/26/2006*
Boring No.	*B-5*	Reviewed By	*CA*
Sample No.	*UDS*	Review Date	*10/30/2006*
Sample Depth	*42-44 ft*	Lab No.	*20836*
Sample Description	*Brown micaceous silty sand*		

ASTM D5084 - Falling Head (Method C RisingTail)

Sample Type:	*UD*
Sample Orientation:	*Vertical*
Initial Water Content, %:	*40.4*
Wet Unit Weight, pcf:	*109.9*
Dry Unit Weight, pcf:	*78.3*
Compaction, %:	*N/A*
Hydraulic Conductivity, cm/sec. @20 °C	***2.8E-05***

Remarks: _____

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

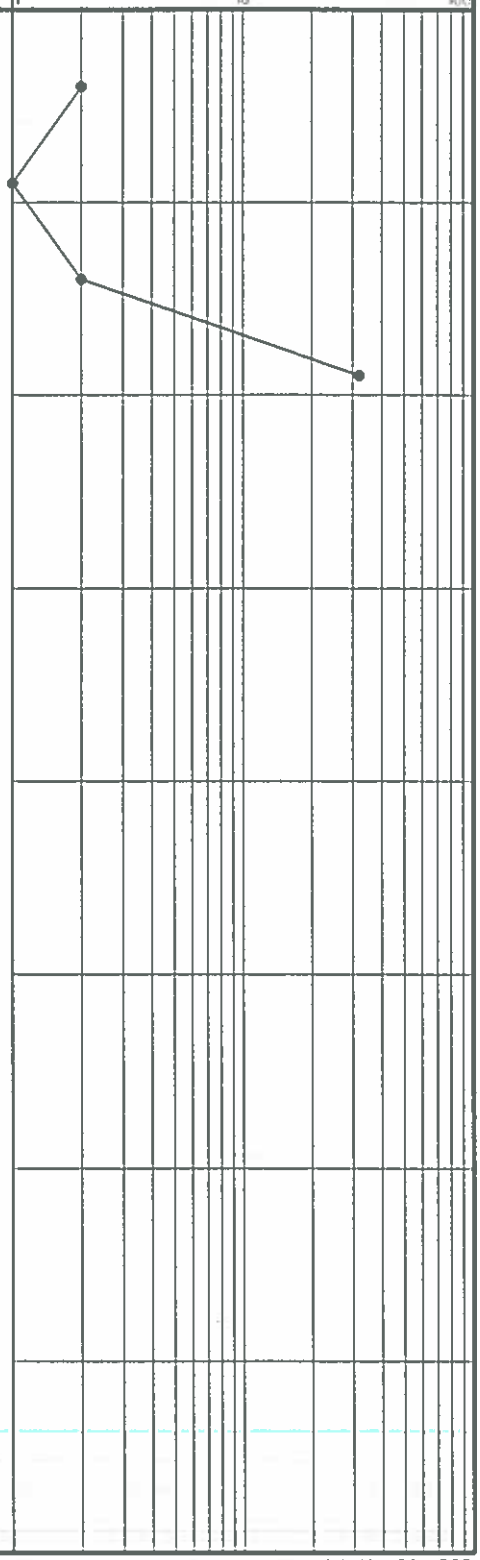
LOG OF BORING B-14

GEOLOGIST: *N/A*	ELEVATION: *1145 Feet*
DATE DRILLED: *10/16/06*	BORING DEPTH: *13 Feet*
DRILLER: *GABLE DRILLING CO.*	WATER LEVEL: *4 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*	

NOTES: Water level at time of boring (▽) was measured at 4 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Soft yellow brown clayey SILT (MH)		2
5		▽	1140.0	1
		No sample recovered at 7.5 feet (black wood recovered in split-spoon sampler at 10 feet)		2
10			1135.0	32
		Augar Refusal on Wood at 13 Feet		
15			1130.0	
20			1125.0	
25			1120.0	
30			1115.0	
35			1110.0	
40			1105.0	

STANDARD PENETRATION RESISTANCE (blows/ft)



Job No. 06-1899

GEOSYSTEMS ENGINEERING, INC.

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

LOG OF BORING B-14A

GEOLOGIST: *N/A*
ELEVATION: *1145 Feet*
DATE DRILLED: *10/16/06*
BORING DEPTH: *15 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *4 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: (1) Water level at time of boring (▽) was measured at 4 Feet. (2) Boring located approximately 5 feet northwest of B-14.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
0		**Auger Boring** – No split-spoon sampling performed (See log of Boring B-14 for soils description)			
5		▽	1140.0		
10			1135.0		
13		**Residuum** – Dense brown micaceous silty fine to medium SAND (SM)		39	
15		Boring Terminated at 15 Feet	1130.0		
20			1125.0		
25			1120.0		
30			1115.0		
35			1110.0		
40			1105.0		

WATER TREATMENT PLANT EXPANSION
CITY OF CUMMING
CUMMING, GEORGIA

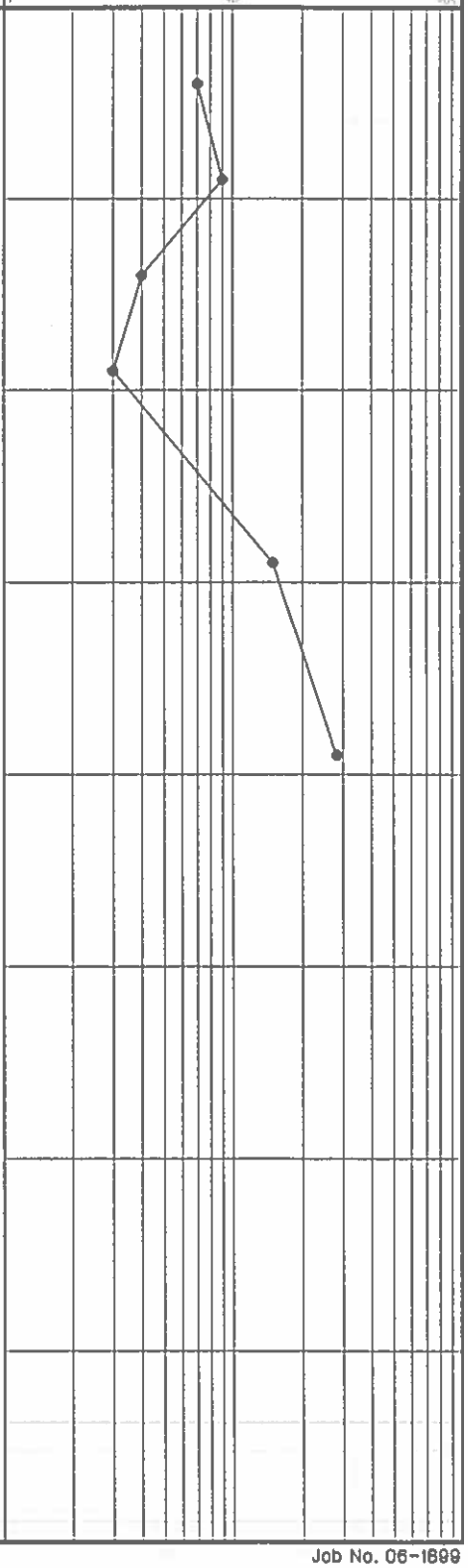
LOG OF BORING B-15

GEOLOGIST: *N/A*
ELEVATION: *1145 Feet*
DATE DRILLED: *10/16/06*
BORING DEPTH: *20 Feet*
DRILLER: *GABLE DRILLING CO.*
WATER LEVEL: *9 Feet*
DRILLING METHOD: *HOLLOW STEM AUGER*

NOTES: Water level at time of boring (▽) was measured at 9 Feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEVATION (feet)	N VALUE
0		**Fill** – Loose orange brown to brown micaceous silty SAND (SM)		7
5			1140.0	9
		Alluvium – Soft dark brown to gray micaceous fine sandy SILT (ML)		4
		▽		
10			1135.0	3
		Alluvium – Medium dense grey clayey fine to medium SAND (SC) with organics		
15			1130.0	15
		Residuum – Dense tan and black silty fine to coarse SAND (SW) with rock fragments		
20		Boring Terminated at 20 Feet	1125.0	28
25			1120.0	
30			1115.0	
35			1110.0	
40			1105.0	

STANDARD PENETRATION RESISTANCE (blows/ft)



GEOSYSTEMS ENGINEERING, INC.

Job No. 06-1899

GEOSYSTEMS
ENGINEERING, INC.

March 7, 2026

Ms. Christa Hopkins
City Engineer
Cumming Utilities
100 Main Street, Suite 401
Cumming, Georgia 30040

Re: Supplementary Geotechnical Exploration Report
City of Cumming
PWPF Clearwell Improvements
Forsyth County, Georgia
GeoSystems Proposal No. 25-3003

Dear Ms. Hopkins:

GeoSystems Engineering, Inc. (GeoSystems) has completed a supplementary geotechnical exploration for the proposed City of Cumming PWPF Clearwell Improvements project. The purpose of this supplementary exploration was to further characterize subsurface conditions at the project site as a result of revisions to the structure locations and elevations. Our previous *Geotechnical Exploration Report* was submitted on January 29, 2026. This supplementary report updates our previous foundation support recommendations and addresses groundwater issues prompted by the revisions to the project. All other conclusions and recommendations in our previous report remain applicable.

REVISED PROJECT INFORMATION

The following summarizes our understanding of the revised design conditions for the project as discussed in our Microsoft Teams Meeting with Ted Turner and David Clark of Stratus on February 18, 2026, and the provided *2026-02-17 Civil Excerpts for Geotech* pdf drawings. This supplementary geotechnical exploration report addresses the structures included in Phase 2 and Phase 3 developments of the site. Except for proposed emergency generators, which were not included previously, these structures were typically relocated at various distances south of the locations referenced in our January 29 report.

Phase 2 Development

A 160-foot diameter, 6.0-million gallon (MG) clearwell, electrical building and emergency generators are included in the Phase 2 development. The clearwell and electrical building construction conditions are as described in our previous report, except the top of slab elevation for the clearwell was lowered 5 feet to 1155.00 feet and the electrical building finished floor elevation is now 8 feet lower at 1150.00 feet.

No details have been provided concerning the emergency generators; however, we expect that foundation support will consist of a shallow mat type foundation on grade. Planned site grade at the location of the generators is shown at 1149 to 1150 feet elevation, which will require about 8 feet of cut below existing site grade in the northwest corner and a maximum of 6 feet of new fill in the southwest corner.

Phase 3 Development

Phase 3 development consists of a future high service pump station (HSPS). As noted in our previous geotechnical exploration report, the HSPS will be conventional CMU type construction. A revised finished floor elevation of 1150 feet is currently planned with a lower top of slab elevation of 1137 feet for an approximate 20-foot wide pipe vault along the west side of the structure. Based on the proposed Phase 2 finished site grades, a maximum cut of 5 or 6 feet will be necessary in the western portion of the structure at the time of construction to achieve the upper floor slab elevation. In the lower pipe vault area, a 17 to 20-foot deep excavation is indicated.

EXPLORATION PROCEDURES

Our supplementary geotechnical exploration included three soil test borings (B-23, B-24 and B-25) in the clearwell location, two borings (B-20 and B-21) in the electrical building, and three (B-18, B-19 and B-22) in the future HSPS location. The boring locations are shown on the enclosed Supplementary Boring Location Plan (Figure 1) prepared from the Detailed Grading Plan, Sheet C-203A, included in the excerpt drawings provided to us. The City of Cumming Utilities staked the boring locations at the site and provided existing grade elevations at the locations prior to the field work. Elevations of the borings in this report were rounded to the nearest 1.0-foot elevation increment from the ground elevations provided by the city. Borings B-18, B-19 and B-23 through B-25 in the clearwell and future HSPS structures were completed to auger refusal depths varying from 31 to 52 feet below ground surface (bgs). Borings B-20, B-21 and B-22, at the corners of the electrical building and HSPS structure along the south side, were terminated at depths of 40 and 50 feet.

Soil test boring, soil sampling operations and preparation of soil test boring logs and subsurface profiles were as described in our previous report. The Supplementary Boring Location Plan, subsurface profiles (Figures 2 through 5) and supplementary soil test boring records, which represent our interpretation of the field subsurface conditions are included as attachments to this report.

SUBSURFACE CONDITIONS

Except at the locations of borings B-18 and B-19, the supplementary borings initially encountered undocumented fill overlying residual soils. The fill is undocumented in terms of there being no previous records on the nature of the fill materials and compaction during placement. Residual soils were found near the ground surface in borings B-18 and B-19. Below the residual soils, partially weathered rock (PWR) and then auger refusal conditions were typically found. Groundwater was encountered in all of the supplementary boring locations at the time of investigation.

Fill

Undocumented fill was initially encountered from near the ground surface to depths of 18 to 23 feet at the boring locations noted above. The fill materials are similar to those previously encountered at the site and consist mainly of silty sand (SM), clayey sand (SC) and low plasticity clay (CL) with rock fragments, asphalt fragments, wood fragments, and other organic matter. Standard penetration resistances in the fill ranged from weight of hammer (WOH) to a maximum of 18 blows per foot (bpf). Weight of hammer is a term used to describe at least 18 inches of penetration by the split-spoon sampler into the soil formation solely under the weight of the 140-pound test hammer.

Residual Soils/Partially Weathered Rock

Residual soils and then partially weathered rock were typically found below the fill and below topsoil in borings B-18 and B-19. Borings B-20 and B-22 were terminated in residual soils at a depth of 40 feet. Residual soils extended to the top of partially weathered rock at depths varying from 28 to 48 feet in the remaining borings. The residual soils encountered in this supplementary exploration were classified predominantly as silty sand (SM) and sandy silt (ML). An upper 6 to 8-foot thick layer of sandy clay (CL) was also penetrated at the locations of borings B-18 and B-19. Standard penetration resistances in the residual soils ranged from a minimum of 2 to a maximum of 77 bpf.

Except for borings B-20 and B-22, continuous 3 to 7-foot thick layers of partially weathered rock were encountered to auger refusal or termination depths in the supplementary borings. The partially weathered rock materials were typically sampled as very dense silty sand (SM).

Auger Refusal Conditions

Hollow stem auger refusal conditions were encountered at depths varying from 31 to 52 feet in all borings, except B-20, B-21 and B-22, that were terminated in the residuum at depths of 40 and 50 feet. Rock core drilling or other exploration methods are required to determine the nature and continuity of refusal material; however, refusal conditions at the boring locations appear to be the upper surface of bedrock.

Groundwater

Groundwater levels were measured at the time of the supplementary field investigation at depths varying approximately from 5 to 27 feet below the existing ground surface. The groundwater level measurements correlate to a water table elevation between 1137 and 1142 feet, as noted in our previous geotechnical exploration. Groundwater is subject to subsurface conditions, runoff, climate, seasonal variations, and other factors; therefore, groundwater conditions at other locations or at other times may be different than reported during this study.

DESIGN & CONSTRUCTION RECOMMENDATIONS

Foundation Support

Our supplementary geotechnical exploration shows the Phase 2 and Phase 3 clearwell improvement structures at the revised locations will be mostly underlain by 10 to 18 feet of undocumented fill at proposed foundation bearing elevations. At a finished floor elevation of 1150 feet, foundation support conditions for the electrical building will include 4 to 6 feet of new structural fill along the east end overlying 10 to 18 feet of existing fill and some alluvium. Boring data from our 2006 investigation shows that 12 to 18 feet of fill and alluvium will underlie the emergency generators area. At the east end of the generators, 5 to 6 feet of new structural fill will also be required. The residual soils below the existing fill and alluvium are also indicated to be relatively weak and compressible at a number of locations.

Due to the difficult subsurface conditions at this site, we recommend that ground improvement measures, as described in our previous exploration report, be implemented to provide uniform support conditions and reliable long-term foundation performance for the clearwell improvement structures. It appears that minor portions of the clearwell in the northwest quadrant and the HSPS along the west side of the structure will bear in undisturbed residual soils and ground improvement measures in these areas may not be necessary. Further coordination with specialty geotechnical contractors is recommended to evaluate if reducing the treatment areas is feasible.

Groundwater Control

In order to achieve the 1137 top of slab elevation for the pipe vault along the west side of the Phase 3 HSPS structure, a deep excavation on the order of 17 to 20 feet below the planned Phase 2 finished grade is anticipated. The excavation is expected to extend below the water table in unconsolidated soils, as indicated by the conditions encountered at the locations of 2025/2026 exploration borings B-10 and B-18, and 2006 boring B-4. We expect that a combination of sloping and temporarily bracing or shoring will be used for excavation protection during the vault installation and proper dewatering of the excavation must be performed to improve excavation conditions and prevent the loss of soil strength or “quick” soil conditions in the unconsolidated soils. Once the entire excavation area has been adequately dewatered, temporary excavation slopes constructed within the upper existing fill soils should be no steeper than 1.5(H):1.0(V). A temporary excavation shoring system to support the deeper excavation should be designed to support earth pressures as subsequently outlined in this report.

Dewatering by pumping from sumps located within the vault excavation is not recommended. This excavation in soil below the water table will require a positive system of dewatering such as staged vacuum well points or deep wells to adequately lower and maintain the groundwater at the required level during construction.

We note that groundwater levels could change considerably based on seasonal and climatic variations and more extensive dewatering may be required if water levels are significantly higher during construction than those indicated during this investigation. The necessity and extent of any dewatering required should be determined in advance of construction to allow sufficient time to lower and maintain groundwater levels at least 3 feet below excavation levels at all times.

QUALIFICATION OF RECOMMENDATIONS

This supplementary geotechnical exploration report has been prepared for the exclusive use of the City of Cumming for design and construction of the proposed PWPF clearwell improvements. Conclusions and recommendations in this report were based on the site and subsurface information obtained and our understanding of the planned site development. The exploratory activities, testing procedures, and evaluation of the data were consistent with the skill and care ordinarily provided by professional geotechnical engineering practice in the Piedmont geologic setting under the same or similar circumstances for projects of this type and at the time of these services. We have made recommendations based on our experience with similar subsurface conditions under similar loading conditions.

Other than the foundation support and groundwater control measures noted, there are no significant changes to the evaluations and conclusions presented in our January 29 report. Seismic site classification, site preparation, earthwork, slope stability, foundation support, lateral earth pressure and inspection recommendations previously presented remain applicable for the revised clearwell improvements structure locations and elevations. Our previous report and this supplementary report should be used together to provide a complete understanding of the project and our geotechnical services. We make no warranties or guarantees, either expressed or implied. GeoSystems is not responsible for the conclusions, opinions or recommendations of others based on our findings and evaluations.

We note that regardless of the thoroughness of a geotechnical exploration there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. If conditions differing from those anticipated are encountered during construction, GeoSystems should review the conditions to address any issues. Should the project plans change substantially from those outlined in this report, we also request the opportunity to review our recommendations in light of any changes.

We appreciate the opportunity to continue working with you on this project. If you have any questions concerning this report or need anything further, please call me.

Sincerely,

GeoSystems Engineering, Inc.



Larry D. Mullins, P.E.
Principal Engineer

Attachments: Supplementary Boring Location Plan (Figure 1)
Subsurface Profiles (Figures 2 through 5)
Keys to Symbols and Classifications
Soil Test Boring Logs (10 pages)

SUPPLEMENTARY BORING LOCATION PLAN

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25-3003

PREPARED BY: ARC
DATE: 3/4/2026
REVIEWED BY: LDM
DATE: 3/4/2026

FIGURE: 1

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: C_PWPF P2 (V2).dwg

CUT/FILL NUMBERS

CUT: 3,275 CY
FILL: 27,006 CY
NET: 23,731 CY (CUT)

B-1 B-2 B-3 B-5 B-6 B-7 B-8 B-9 B-10 B-11 B-12 B-13 B-14 B-15 B-16 B-17 B-18 B-19 B-20 B-21 B-22 B-23 B-24 B-25

A A' B B' C C' D D' E E' F F' G G'

PROPOSED ELECTRICAL BUILDING FFE – 1150.00

Future HSPS FFE = 1150.00

PROPOSED CLEARWELL FFE – 1155.00

Z1-SSMH Z2-SSMH Z3-SSMH

7 C-301 SEWER LINE Z

5 C-301 STORM LINE C

6 C-301 STORM LINE D

EXISTING 1 MG CLEARWELL

EXISTING 2 MG CLEARWELL

ASPHALT PAVEMENT

ASPHALT ROAD

ADMIN/LAB

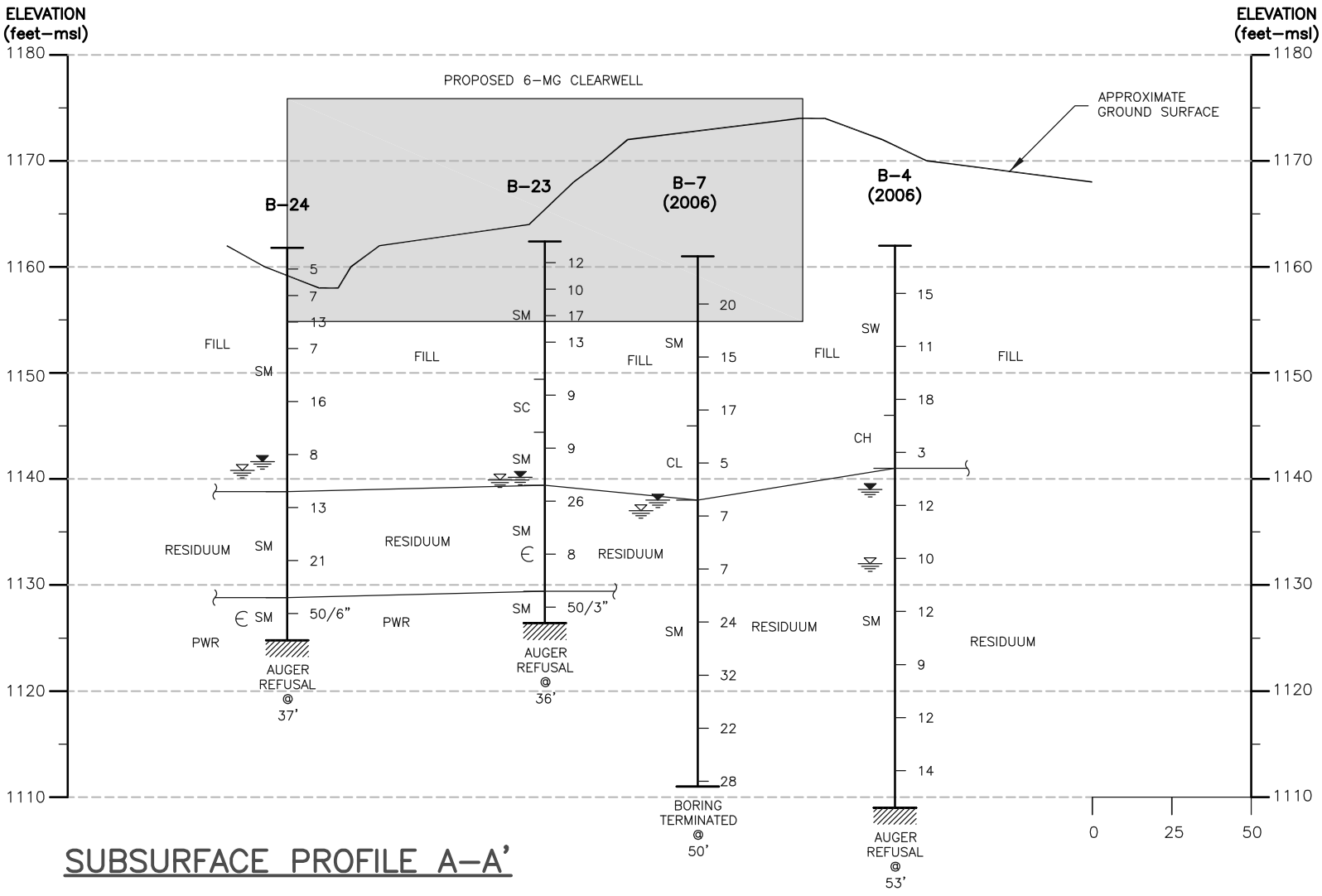
25' STATE STREAM BUFFER

SOURCE:
Detailed Grading Plan, Sheet C-203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME

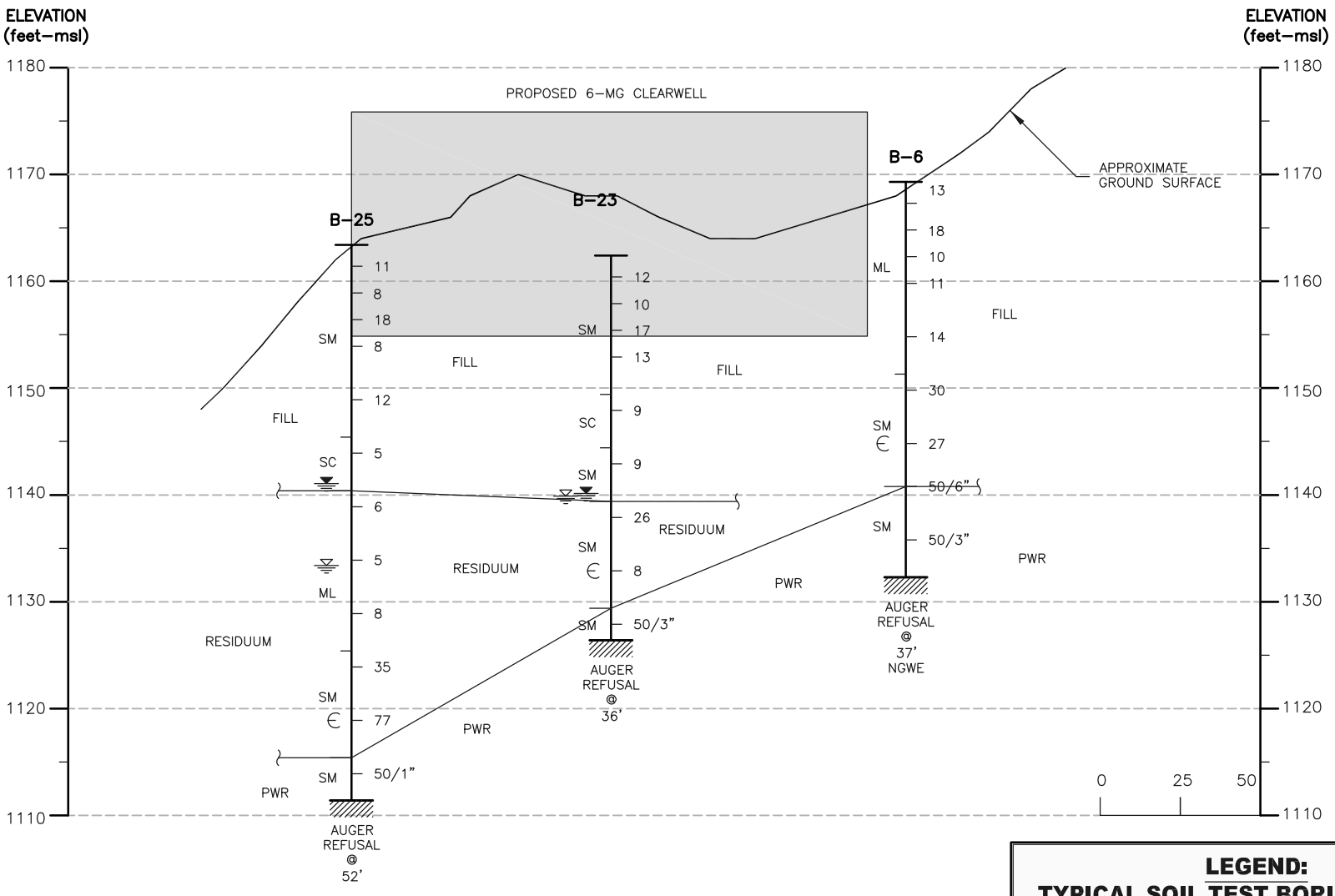
LEGEND
– SUPPLEMENTARY SOIL TEST BORING (2026 EXPLORATION)
– SOIL TEST BORING (2025)
– SOIL TEST BORING (2006)

SCALE: 1" = 60' (APPROXIMATELY)

0 30 60



SUBSURFACE PROFILE A–A'

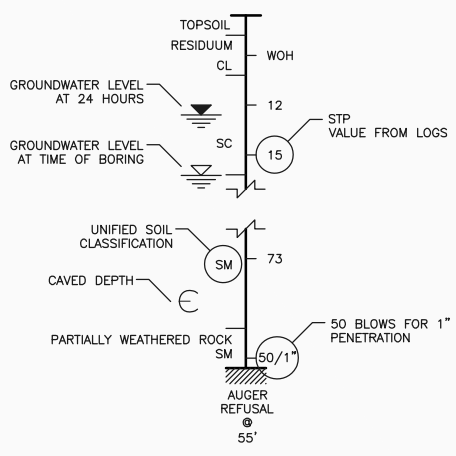


SUBSURFACE PROFILE B–B'

NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C–203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

OH – HIGH PLASTICITY ORGANICS
ML – LOW PLASTICITY SILT
SM – SILTY SAND
SP – POORLY GRADED SAND
SW – WELL GRADED SAND
CL – LOW PLASTICITY CLAY
CH – HIGH PLASTICTY CLAY

ADDITIONAL ABBREVIATIONS

SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR – NO RECOVERY
PWR – PARTIALLY WEATHERED ROCK
NGWE– NO GROUNDWATER ENCOUNTERED

LEGEND

SCALE AS SHOWN (APPROXIMATE)

GEOSYSTEMS ENGINEERING, INC.

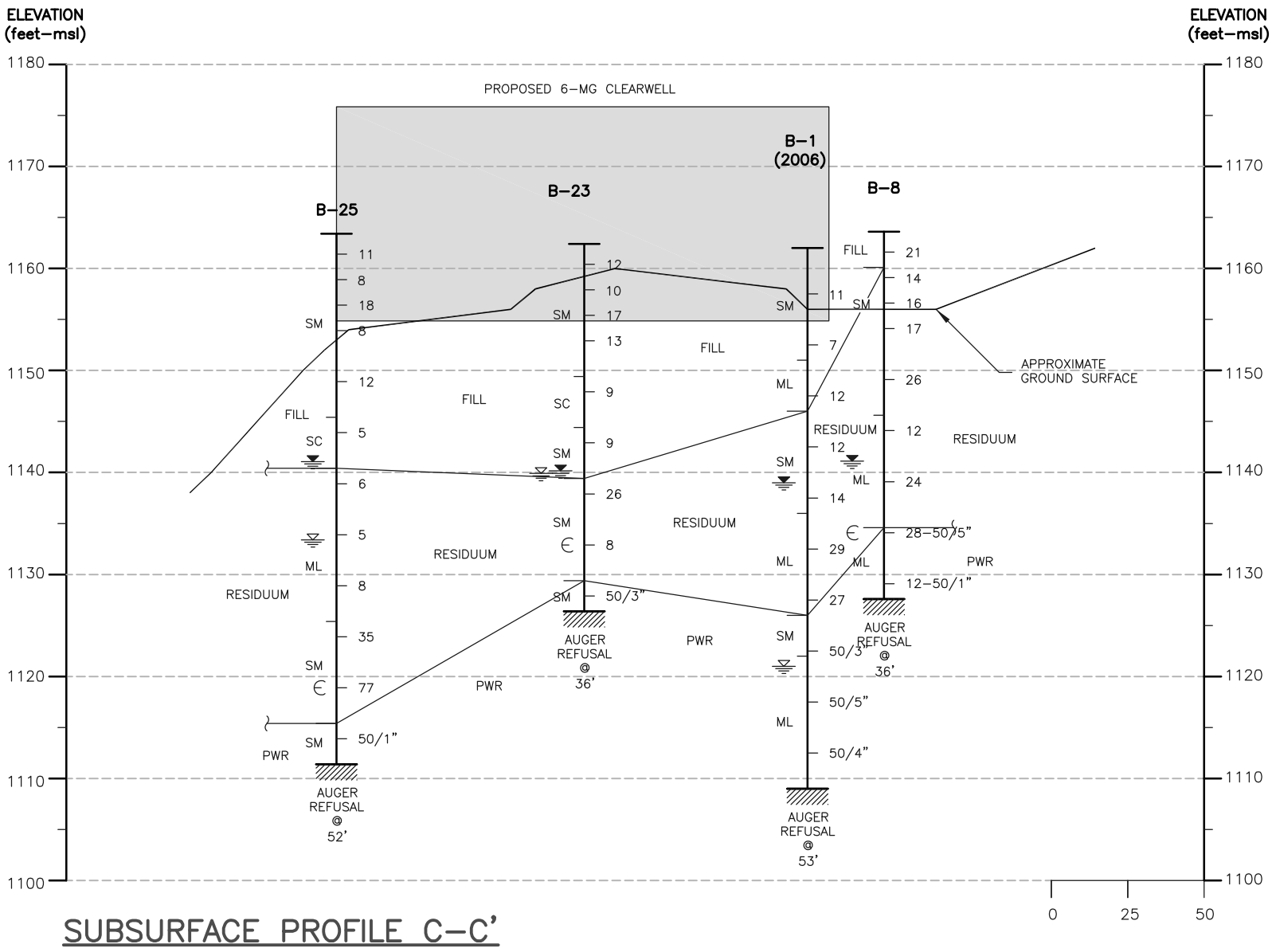
REFERENCE: BCW BLP.dwg

SUBSURFACE PROFILES

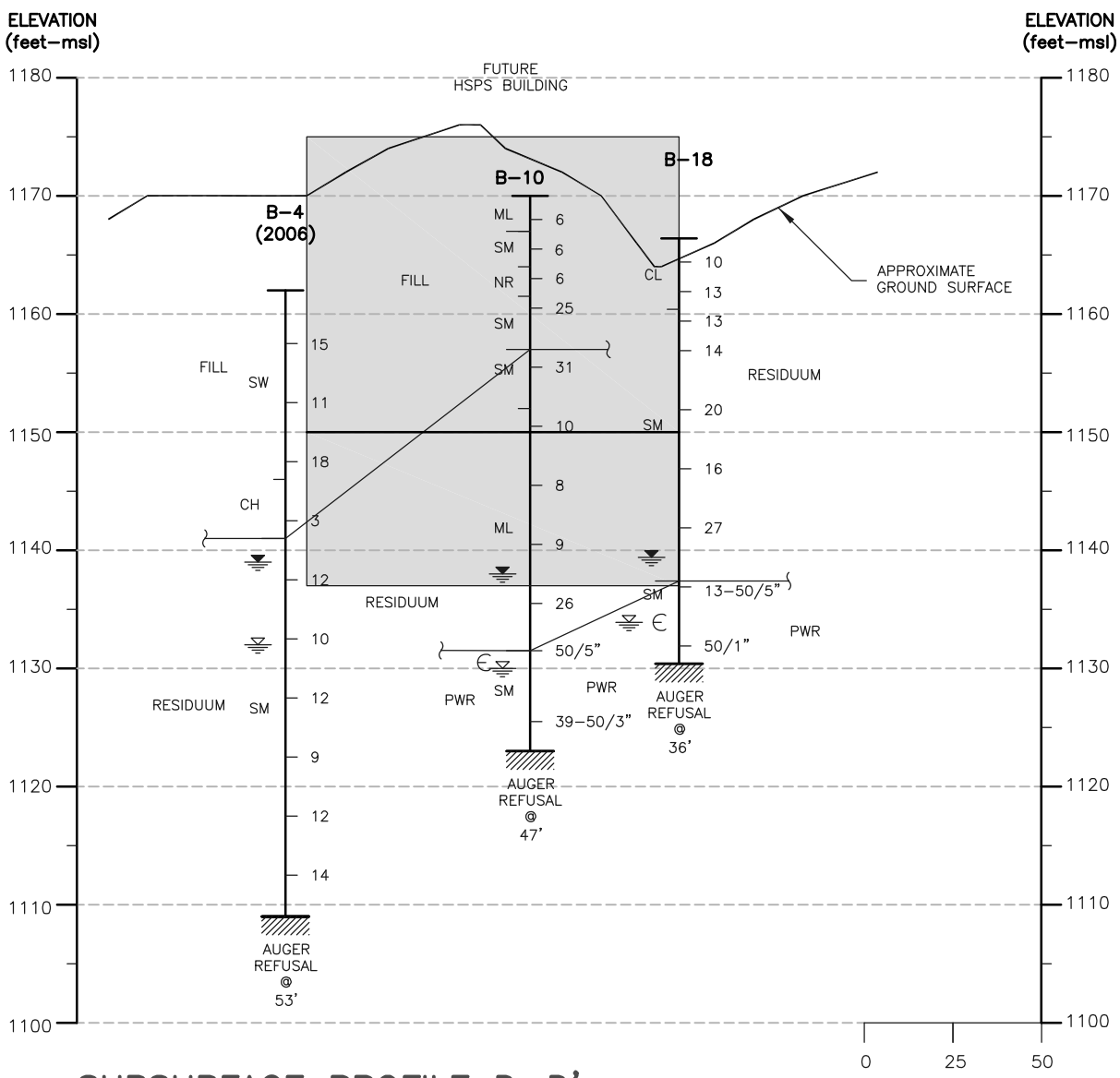
PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE: 2



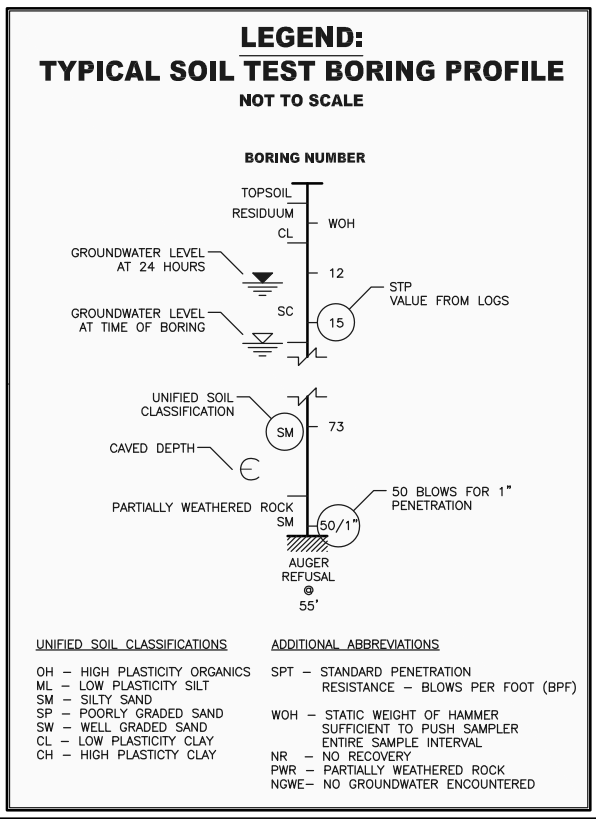
SUBSURFACE PROFILE C–C'



SUBSURFACE PROFILE D–D'

NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C–203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.



LEGEND

SCALE AS SHOWN (APPROXIMATE)

GEOSYSTEMS ENGINEERING, INC.

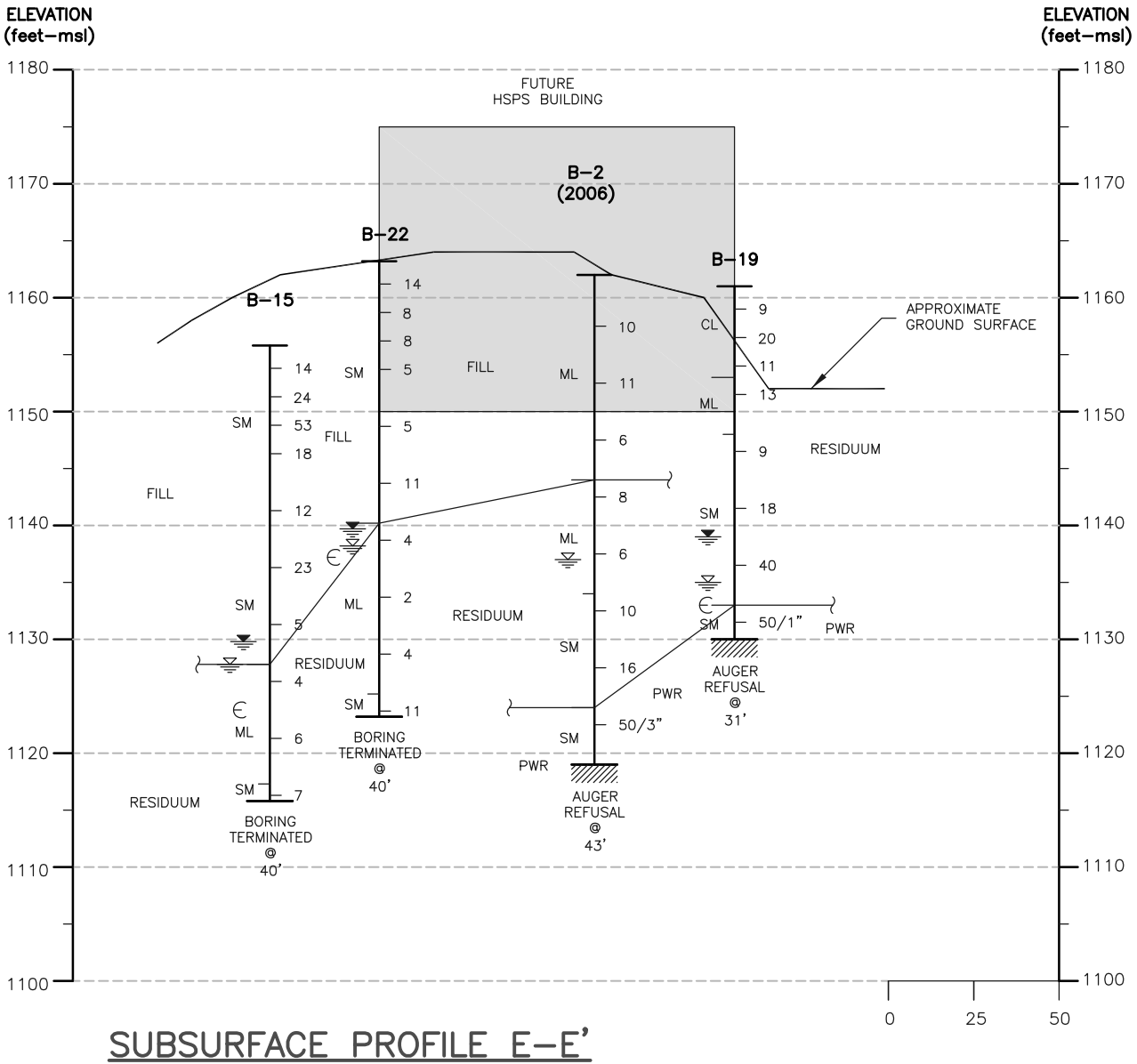
REFERENCE: BCW BLP.dwg

SUBSURFACE PROFILES

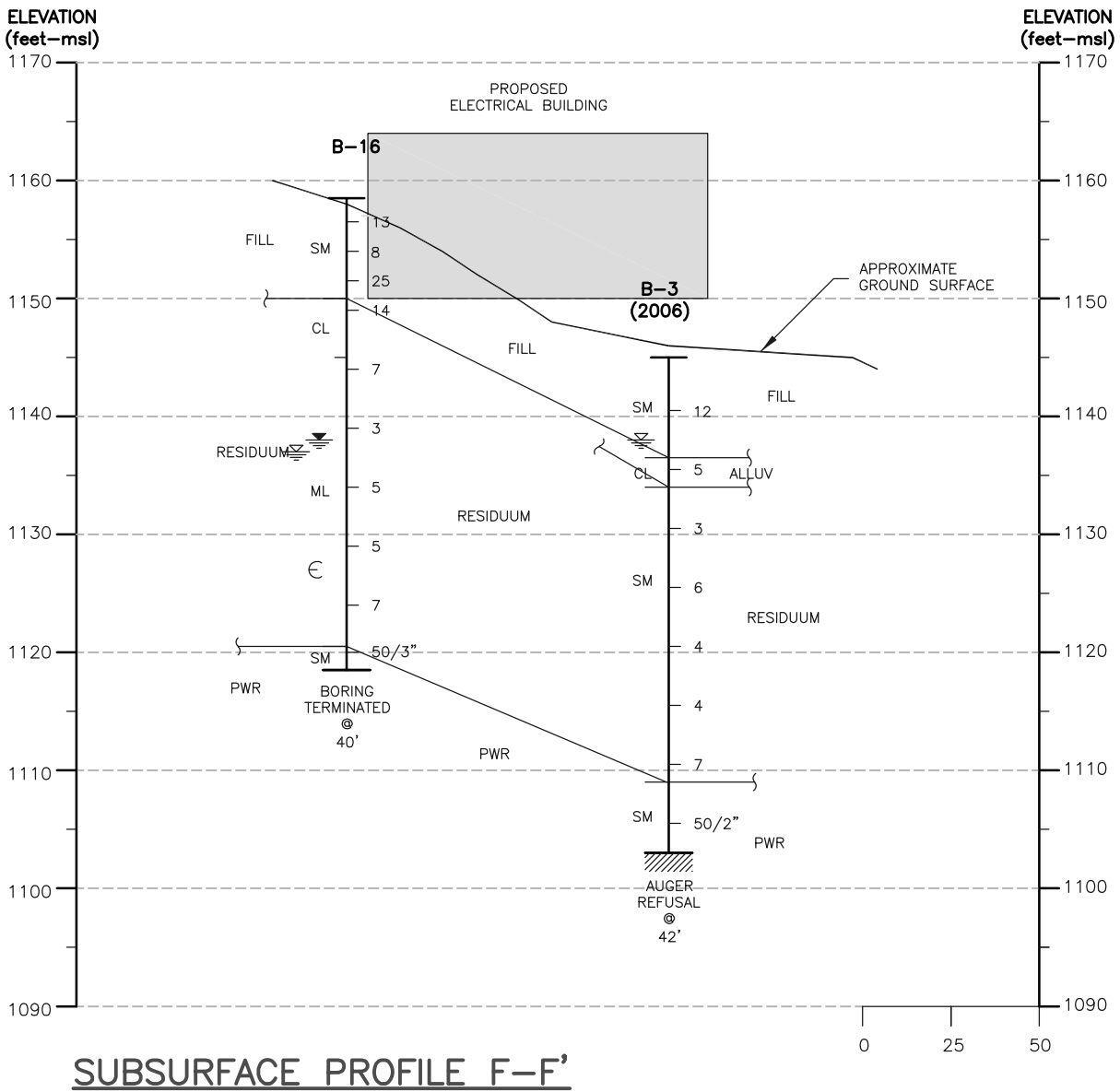
PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE: 3

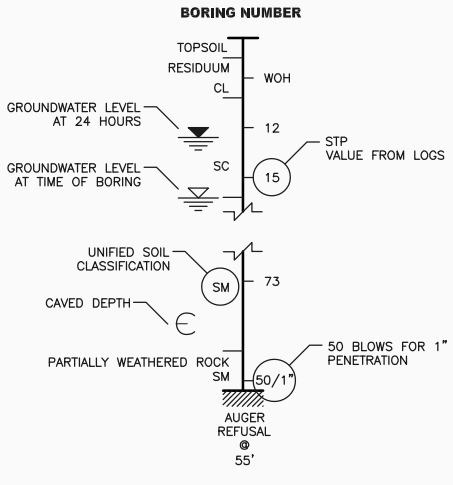


SUBSURFACE PROFILE E–E'



SUBSURFACE PROFILE F–F'

LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

OH – HIGH PLASTICITY ORGANICS
ML – LOW PLASTICITY SILT
SM – SILTY SAND
SP – POORLY GRADED SAND
SW – WELL GRADED SAND
CL – LOW PLASTICITY CLAY
CH – HIGH PLASTICTY CLAY

ADDITIONAL ABBREVIATIONS

SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR – NO RECOVERY
PWR – PARTIALLY WEATHERED ROCK
NGWE– NO GROUNDWATER ENCOUNTERED

NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C–203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

LEGEND

SCALE AS SHOWN (APPROXIMATE)

GEOSYSTEMS ENGINEERING, INC.

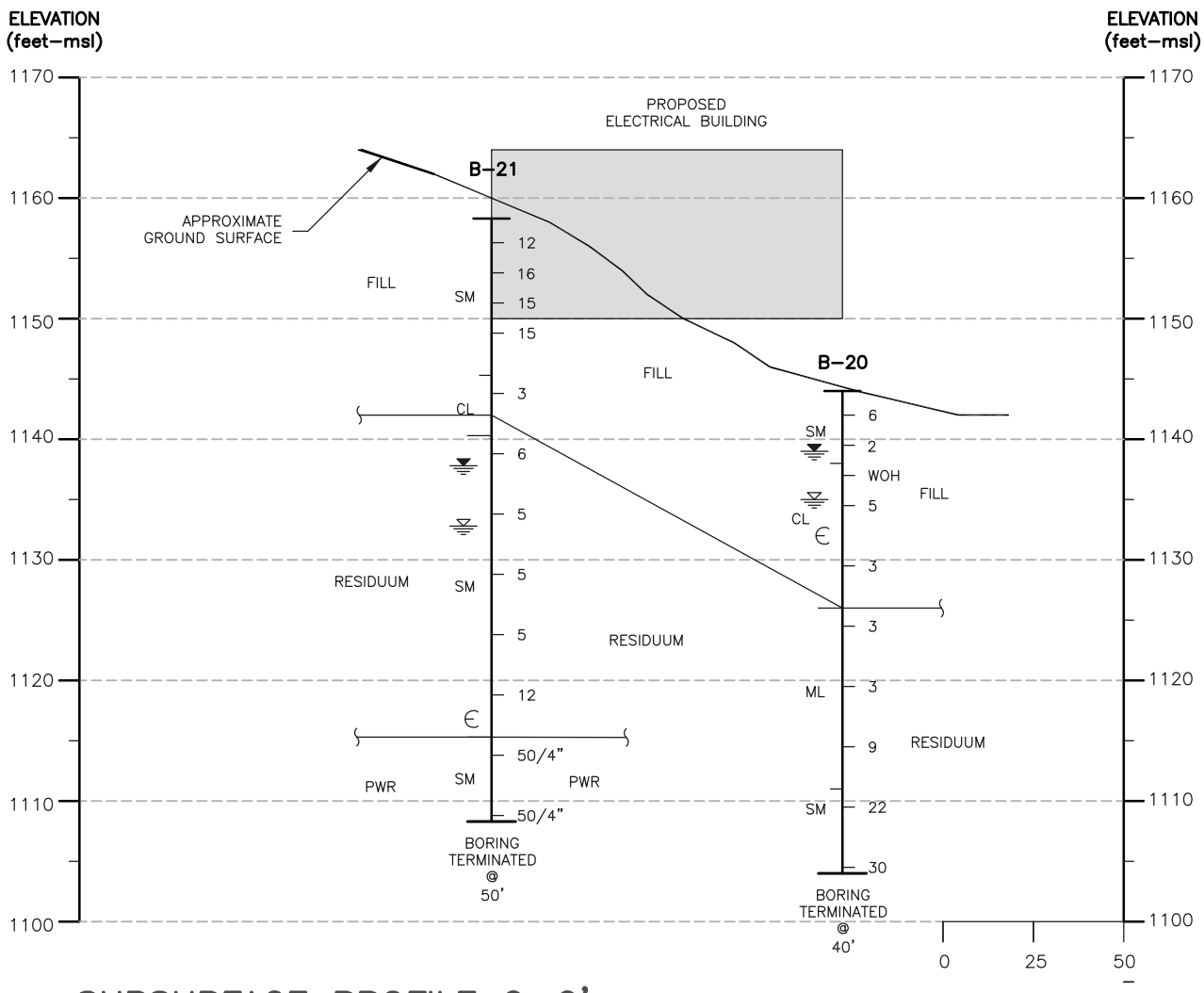
REFERENCE: BCW BLP.dwg

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE: 4

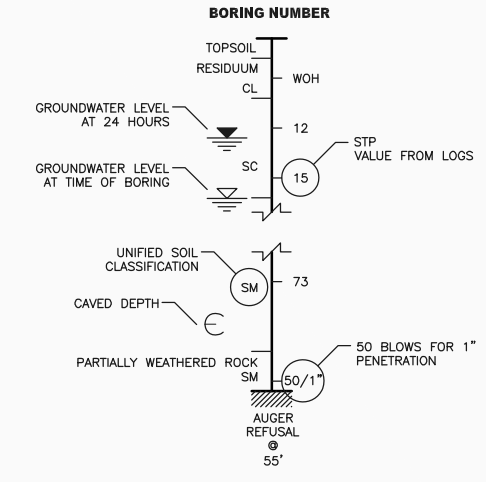


SUBSURFACE PROFILE G–G'

NOTES:

1. Approximate ground surface is plotted from the Detailed Grading Plan, Sheet C–203A, dated January 29, 2026, revision E, dated February 6, 2026, prepared by PRIME.
2. Current soil test borings are plotted at surveyed elevations provided by City of Cumming Utilities.
3. Previous 2006 soil test borings are plotted at elevations listed in the surbsurface investigation report, dated November 14, 2006.

LEGEND:
TYPICAL SOIL TEST BORING PROFILE
NOT TO SCALE



UNIFIED SOIL CLASSIFICATIONS

OH – HIGH PLASTICITY ORGANICS
ML – LOW PLASTICITY SILT
SM – SILTY SAND
SP – POORLY GRADED SAND
SW – WELL GRADED SAND
CL – LOW PLASTICITY CLAY
CH – HIGH PLASTICTY CLAY

ADDITIONAL ABBREVIATIONS

SPT – STANDARD PENETRATION RESISTANCE – BLOWS PER FOOT (BPF)
WOH – STATIC WEIGHT OF HAMMER SUFFICIENT TO PUSH SAMPLER ENTIRE SAMPLE INTERVAL
NR – NO RECOVERY
PWR – PARTIALLY WEATHERED ROCK
NGWE– NO GROUNDWATER ENCOUNTERED

LEGEND

SCALE AS SHOWN (APPROXIMATE)

GEOSYSTEMS ENGINEERING, INC.

REFERENCE: BCW BLP.dwg

SUBSURFACE PROFILES

PROJECT: CITY OF CUMMING, GEORGIA
PWPF PHASE 2 CLEARWELL IMPROVEMENTS
935 DAHLONEGA, FORSYTH COUNTY, GA
GEOSYSTEMS PROJECT NUMBER: 25–3003

PREPARED BY: ARC
DATE: 3/3/2026
REVIEWED BY: LDM
DATE: 3/3/2026

FIGURE: 5

KEYS TO SYMBOLS AND CLASSIFICATIONS

SPECIAL STRATIGRAPHY IDENTIFIERS USED TO HIGHLIGHT SPECIFIC LAYERS	FILL TOPSOIL PAVEMENT	PARTIALLY WEATHERED ROCK ROCK (GENERAL) WATER ALLUVIUM
COARSE GRAINED SOIL - GRAVELS & SANDS (MORE THAN 50% OF MATERIAL IS RETAINED ON NO. 200 SIEVE)	CLEAN SANDS & GRAVELS (< 5% FINES CONTENT)	SP: Poorly graded sands SW: Well graded sands GP: Poorly graded gravels GW: Well graded gravels
	SANDS & GRAVELS WITH HIGH FINES CONTENT (> 15% FINES CONTENT)	SM: Silty sands GM: Silty gravels SC: Clayey sands GC: Clayey gravels
FINE GRAINED SOIL - SILTS & CLAYS (MORE THAN 50% OF MATERIAL PASSES NO. 200 SEIVE)	SILTS	ML: Low plasticity inorganic silts MH: High plasticity inorganic silts
	CLAYS	CL: Low placticity inorganic clays CH: High plasticity inorganic clays
	ORGANIC SILTS & CLAYS	OL: Low plasticity organic silts and clays OH: High plasticity organic silts and clays

CORRELATION OF PENETRATION RESISTANCE WITH RELATIVE DENSITY AND CONSISTENCY

	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE DENSITY
SANDS AND GRAVELS	0 - 4	Very Loose
	5 - 10	Loose
	11 - 30	Medium Dense
	31 - 50	Dense
	OVER 50	Very Dense
	NUMBER OF BLOWS, N	APPROXIMATE RELATIVE CONSISTENCY
SILTS AND CLAYS	0 - 1	Very Soft
	2 - 4	Soft
	5 - 8	Firm
	9 - 15	Stiff
	16 - 30	Very Stiff
	31 - 50	Hard
	OVER 50	Very Hard

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-18

GEOLOGIST: *NA*	ELEVATION (feet): *1166*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *36*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *32* ▼ 24HR (feet): *27*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 32 feet at the time of boring. 2. Groundwater level measured at 27 feet approximately 6 hours after drilling. 3. Borehole caved to a depth of 32.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	3" - TOPSOIL	1166	
	RESIDUUM: Stiff reddish brown slightly micaceous sandy CLAY (CL)		10
5		1161	13
	Medium dense grayish brown micaceous silty fine SAND (SM), slightly moist		13
10		1156	14
	Medium dense brown and white micaceous silty fine to medium SAND (SM), moist		20
15		1151	
	Medium dense dark brownish gray micaceous silty fine to medium SAND (SM), moist		16
20		1146	
			27
25		1141	
	PARTIALLY WEATHERED ROCK: Sampled as very dense dark gray micaceous silty fine SAND (SM), moist		13-50/5"
30		1136	
	Sampled as very dense dark gray slightly micaceous silty fine SAND (SM), small rock fragments, moist		50/1"
35		1131	
	Auger Refusal at 36 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

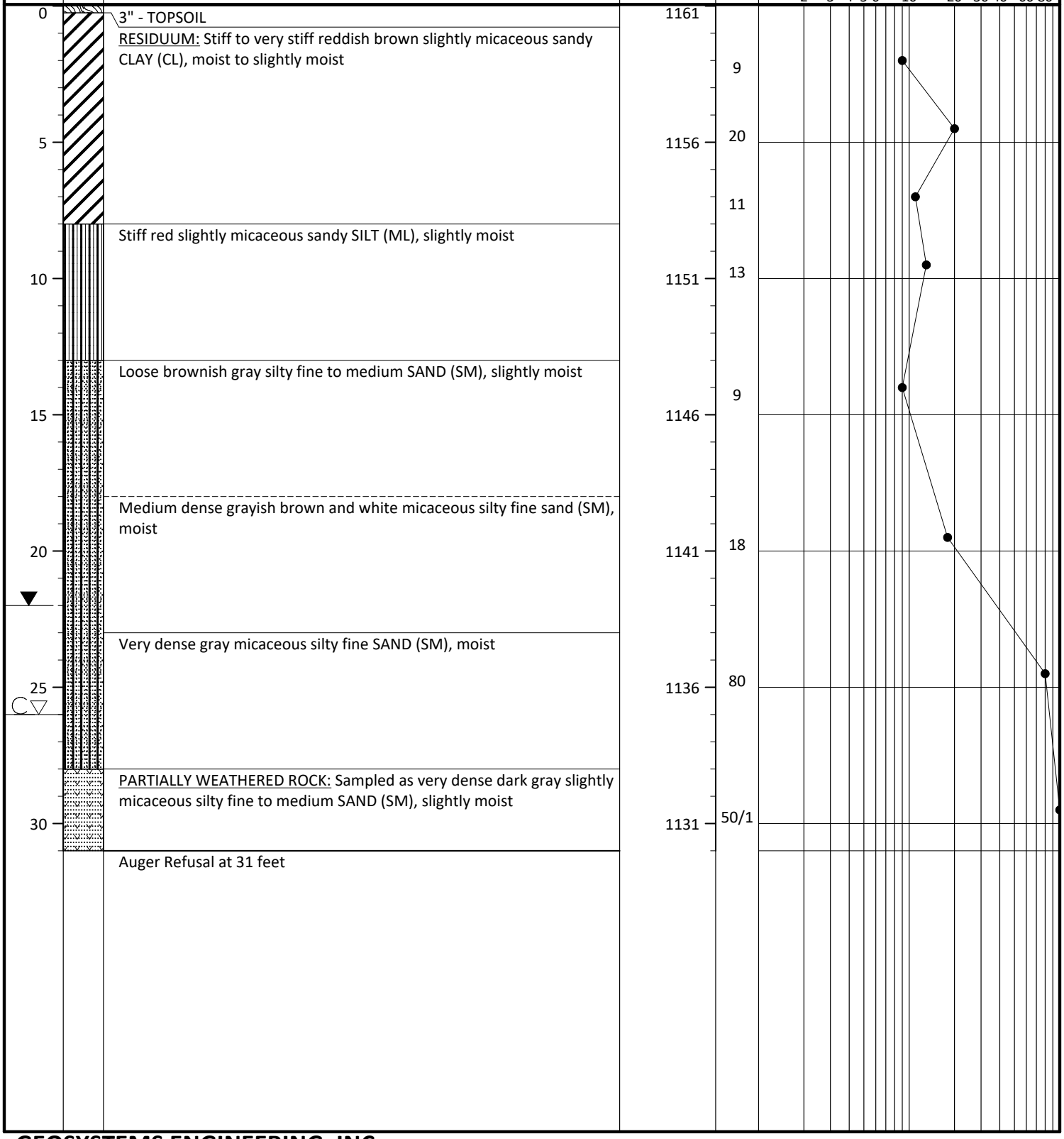
LOG OF BORING B-19

GEOLOGIST: *NA*	ELEVATION (feet): *1161*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *31*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL ▽ TOB (feet): *26* ▼ 24HR (feet): *22*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 26 feet at the time of boring. 2. Groundwater level measured at 22 feet approximately 5 hours after drilling. 3. Borehole caved to a depth of 26 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		3" - TOPSOIL	1161	
		RESIDUUM: Stiff to very stiff reddish brown slightly micaceous sandy CLAY (CL), moist to slightly moist		9
5			1156	20
				11
		Stiff red slightly micaceous sandy SILT (ML), slightly moist		
10			1151	13
		Loose brownish gray silty fine to medium SAND (SM), slightly moist		9
15			1146	
		Medium dense grayish brown and white micaceous silty fine sand (SM), moist		
20			1141	18
▼				
		Very dense gray micaceous silty fine SAND (SM), moist		
25			1136	80
C ▽				
		PARTIALLY WEATHERED ROCK: Sampled as very dense dark gray slightly micaceous silty fine to medium SAND (SM), slightly moist		
30			1131	50/1
		Auger Refusal at 31 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

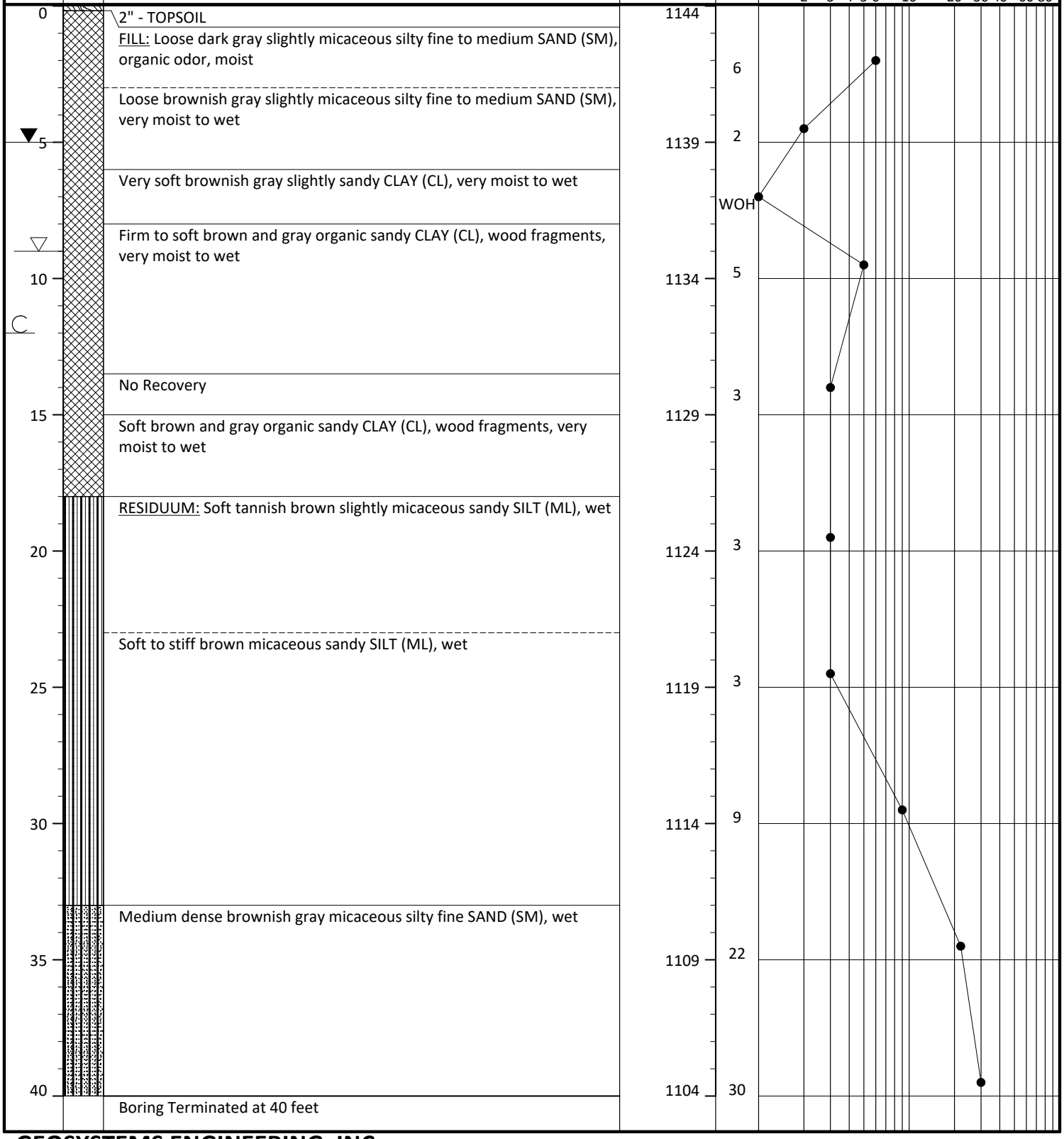
LOG OF BORING B-20

GEOLOGIST: *NA*	ELEVATION (feet): *1144*
DATE DRILLED: *2/24/2026*	BORING DEPTH (feet): *40*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *9* 24HR (feet): *5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 9 feet at the time of boring. 2. Groundwater level measured at 5 feet approximately 4 hours after drilling. 3. Borehole caved to a depth of 12 feet. 4. Weight of hammer (WOH).

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - TOPSOIL	1144	
		FILL: Loose dark gray slightly micaceous silty fine to medium SAND (SM), organic odor, moist		6
5		Loose brownish gray slightly micaceous silty fine to medium SAND (SM), very moist to wet	1139	2
		Very soft brownish gray slightly sandy CLAY (CL), very moist to wet		WOH
10		Firm to soft brown and gray organic sandy CLAY (CL), wood fragments, very moist to wet	1134	5
15		No Recovery	1129	3
		Soft brown and gray organic sandy CLAY (CL), wood fragments, very moist to wet		
20		RESIDUUM: Soft tannish brown slightly micaceous sandy SILT (ML), wet	1124	3
25		Soft to stiff brown micaceous sandy SILT (ML), wet	1119	3
30			1114	9
35		Medium dense brownish gray micaceous silty fine SAND (SM), wet	1109	22
40		Boring Terminated at 40 feet	1104	30

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-21

GEOLOGIST: *NA*	ELEVATION (feet): *1158*
DATE DRILLED: *2/24/2026*	BORING DEPTH (feet): *50*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *25.5* 24HR (feet): *20.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 25.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet approximately 19 hours after drilling. 3. Borehole caved to a depth of 40 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - TOPSOIL	1158	
		FILL: Medium dense brown slightly micaceous silty fine to medium SAND (SM), rock fragments		12
		No recovery		16
5		Medium dense light reddish brown to brown slightly micaceous silty fine to medium SAND (SM), rock fragments	1153	15
				15
10		Soft reddish brown and grayish brown sandy CLAY (CL), moist	1148	3
15		RESIDUUM: Loose light yellowish brown and brown silty fine to medium SAND (SM), very moist	1143	6
20 ▼		Loose grayish brown silty fine to medium SAND (SM) , very moist	1138	5
25 ▽		Loose yellowish brown and white silty fine to medium SAND (SM), wet	1133	5
30		Loose brown silty fine to medium SAND (SM), wet	1128	5
35		Medium dense grayish brown silty fine to medium SAND (SM), very moist to wet	1123	12
40			1118	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-21

GEOLOGIST: *NA*	ELEVATION (feet): *1158*
DATE DRILLED: *2/24/2026*	BORING DEPTH (feet): *50*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *25.5* 24HR (feet): *20.5*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 25.5 feet at the time of boring. 2. Groundwater level measured at 20.5 feet approximately 19 hours after drilling. 3. Borehole caved to a depth of 40 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
		Medium dense grayish brown silty fine to medium SAND (SM), very moist to wet			
		PARTIALLY WEATHERED ROCK: Sampled as very dense grayish brown micaceous silty fine SAND (SM), very moist		43-	
45			1113	50/4"	
		Sampled as very dense dark gray micaceous silty fine SAND (SM), very moist			
50			1108	50/4"	
		Boring Terminated at 50 feet			

2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

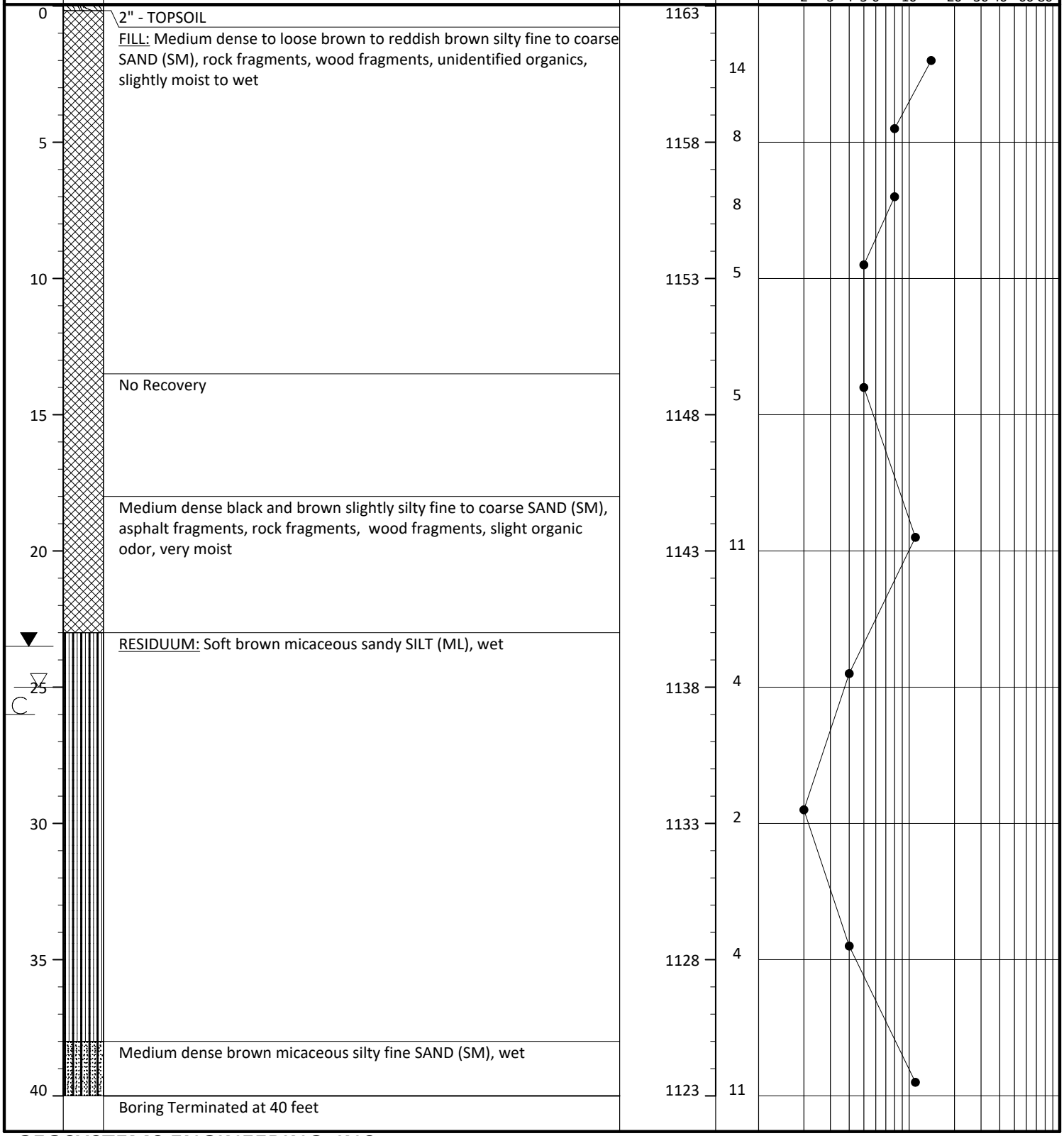
CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-22

GEOLOGIST: *NA*	ELEVATION (feet): *1163*	NOTES: 1. Groundwater detected at 25 feet at the time of boring. 2. Groundwater level measured at 23.5 feet approximately 16 hours after drilling. 3. Borehole caved to a depth of 26 feet.
DATE DRILLED: *2/24/2026*	BORING DEPTH (feet): *40*	
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *25* 24HR (feet): *23.5*	
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*		

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - TOPSOIL	1163	
		FILL: Medium dense to loose brown to reddish brown silty fine to coarse SAND (SM), rock fragments, wood fragments, unidentified organics, slightly moist to wet		14
5			1158	8
				8
10			1153	5
		No Recovery		5
15			1148	
		Medium dense black and brown slightly silty fine to coarse SAND (SM), asphalt fragments, rock fragments, wood fragments, slight organic odor, very moist		11
20			1143	
		RESIDUUM: Soft brown micaceous sandy SILT (ML), wet		4
25			1138	
30			1133	2
35			1128	4
		Medium dense brown micaceous silty fine SAND (SM), wet		11
40		Boring Terminated at 40 feet	1123	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-23

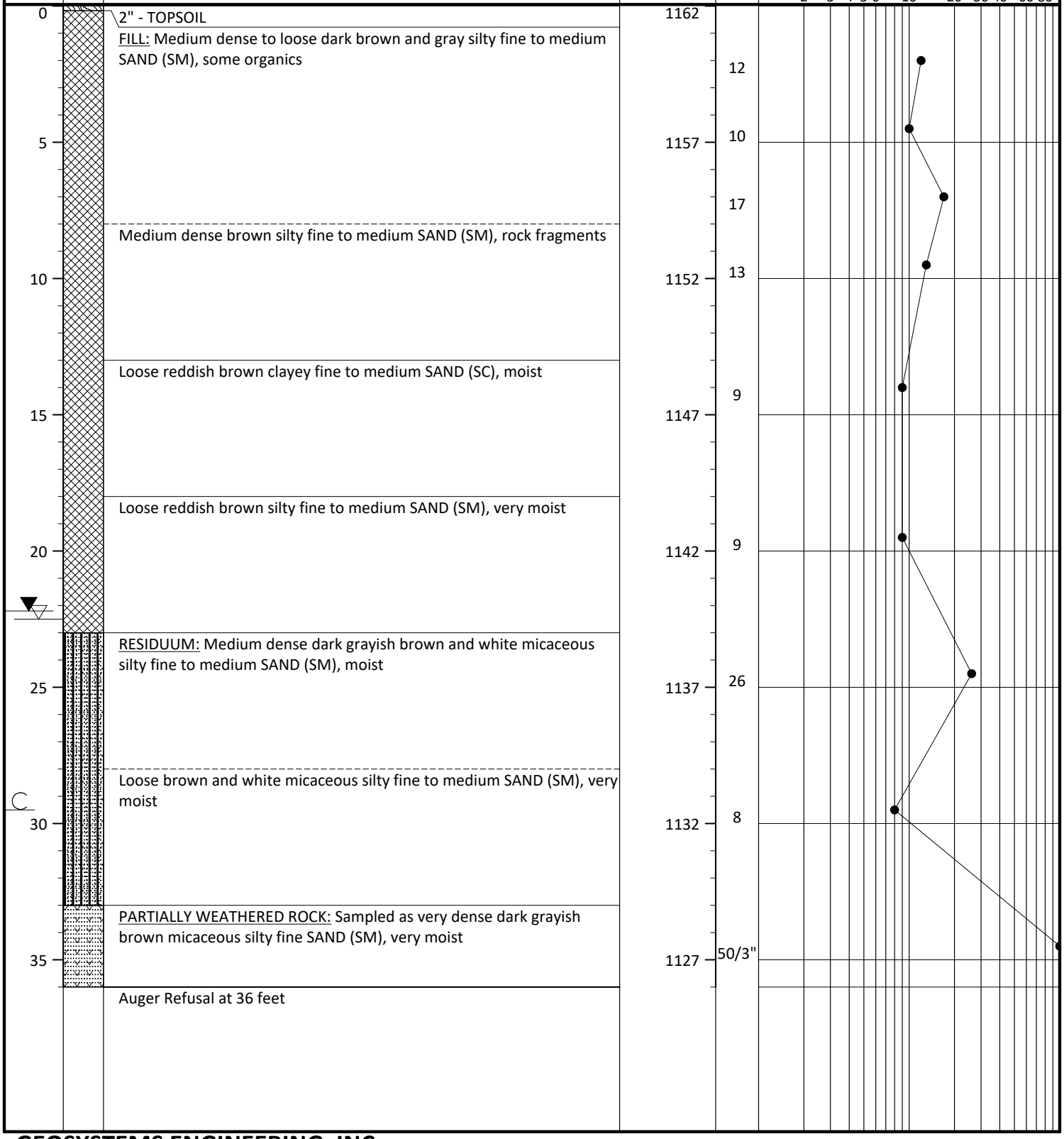
GEOLOGIST: *NA*	ELEVATION (feet): *1162*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *36*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *22.5* 24HR (feet): *22.2*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 22.5 feet at the time of boring. 2. Groundwater level measured at 22.2 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 29.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - TOPSOIL	1162	
		FILL: Medium dense to loose dark brown and gray silty fine to medium SAND (SM), some organics		12
5			1157	10
				17
		Medium dense brown silty fine to medium SAND (SM), rock fragments		
10			1152	13
		Loose reddish brown clayey fine to medium SAND (SC), moist		
				9
15			1147	
		Loose reddish brown silty fine to medium SAND (SM), very moist		
20			1142	9
		RESIDUUM: Medium dense dark grayish brown and white micaceous silty fine to medium SAND (SM), moist		
25			1137	26
		Loose brown and white micaceous silty fine to medium SAND (SM), very moist		
30			1132	8
		PARTIALLY WEATHERED ROCK: Sampled as very dense dark grayish brown micaceous silty fine SAND (SM), very moist		
35			1127	50/3"
		Auger Refusal at 36 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)

2 3 4 5 6 10 20 30 40 60 80



GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-24

GEOLOGIST: *NA*	ELEVATION (feet): *1162*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *37*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *21* 24HR (feet): *20.2*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 21 feet at the time of boring. 2. Groundwater level measured at 20.2 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 35 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0		2" - TOPSOIL	1162	
		FILL: Loose grayish brown silty fine to medium SAND (SM), rock fragments, slightly moist		5
		Loose reddish brown silty fine to medium SAND (SM), rock fragments		7
5			1157	
		Medium dense light brown silty fine to medium SAND (SM), rock fragments		13
		Loose brown slightly micaceous silty fine to medium SAND (SM)		7
10			1152	
		Medium dense reddish brown and gray slightly micaceous silty fine to medium SAND (SM)		16
15			1147	
		Loose reddish brown slightly micaceous silty fine to medium SAND (SM), rock fragments		8
20 ▼ ▽			1142	
		RESIDUUM: Medium dense dark grayish brown and white micaceous silty fine to medium SAND (SM), very moist		13
25			1137	
		Medium dense dark brown slightly micaceous silty fine to medium SAND (SM) , moist		21
30			1132	
		PARTIALLY WEATHERED ROCK: Sampled as very dense dark brown micaceous silty fine to medium SAND (SM), moist		50/6"
35 C			1127	
		Auger Refusal at 37 feet		

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-25

GEOLOGIST: *NA*	ELEVATION (feet): *1163*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *52*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *30* 24HR (feet): *22.3*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 30 feet at the time of boring. 2. Groundwater level measured at 22.3 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.

DEPTH (feet)	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE
0	2" - TOPSOIL	1163	
	FILL: Medium dense brown and gray silty fine to medium SAND (SM), rock fragments		11
5	Loose to medium dense reddish brown silty fine to medium SAND (SM), slightly moist	1158	8
			18
	Loose light brown silty fine to medium SAND (SM), slightly moist		8
10		1153	
	Medium dense brown silty fine to medium SAND (SM), slightly moist		12
15		1148	
	Loose brown clayey fine SAND (SC), organics, organic odor		5
20		1143	
	RESIDUUM: Firm light yellowish brown and gray to brown micaceous sandy SILT (ML), wet		6
25		1138	
30		1133	5
	Firm grayish brown micaceous sandy SILT (ML), wet		8
35		1128	
	Dense dark gray and white to dark grayish brown slightly micaceous silty fine to coarse SAND (SM), wet		35
40		1123	

STANDARD PENETRATION RESISTANCE (blows/ft)
2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003

CITY OF CUMMING, GEORGIA
PWPF CLEARWELL IMPROVEMENTS - PHASE 2
FORSYTH COUNTY, GEORGIA

LOG OF BORING B-25

GEOLOGIST: *NA*	ELEVATION (feet): *1163*
DATE DRILLED: *2/25/2026*	BORING DEPTH (feet): *52*
DRILLER: *GRINDSTONE DRILLING*	WATER LEVEL TOB (feet): *30* 24HR (feet): *22.3*
DRILLING METHOD: *HOLLOW STEM AUGER WTIH AUTOMATIC HAMMER*	

NOTES: 1. Groundwater detected at 30 feet at the time of boring. 2. Groundwater level measured at 22.3 feet approximately 24 hours after drilling. 3. Borehole caved to a depth of 44.5 feet.

DEPTH (feet)	GRAPHIC LOG	GEOLOGIC DESCRIPTION	ELEV (feet)	N VALUE	STANDARD PENETRATION RESISTANCE (blows/ft)
		Dense dark gray and white to dark grayish brown slightly micaceous silty fine to coarse SAND (SM), wet			
45		Very dense dark grayish brown slightly micaceous silty fine to coarse SAND (SM), rock fragments, wet	1118	77	
50		PARTIALLY WEATHERED ROCK: Sampled as very dense dark gray slightly micaceous silty fine SAND (SM), wet	1113	50/1"	
		Auger Refusal at 52 feet			

STANDARD PENETRATION RESISTANCE (blows/ft): 2 3 4 5 6 10 20 30 40 60 80

GEOSYSTEMS ENGINEERING, INC.

JOB NO. 25-3003