Fort Mill School District
Alternative School Modular

1599 FARM HOUSE DRIVE

FORT MILL, SOUTH CAROLINA 29715

FORT MILL SCHOOL DISTRICT

Issue for Bid

05.10.2023

mcmillan pazdan smith ARCHITECTURE

1422 TYRON STREET · SUITE 700 · CHARLOTTE, NORTH CAROLINA · (908) 201-3035

SC FIRM LICENSE # ARF.100573

ARCHITECT PROJECT 023142.00

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1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

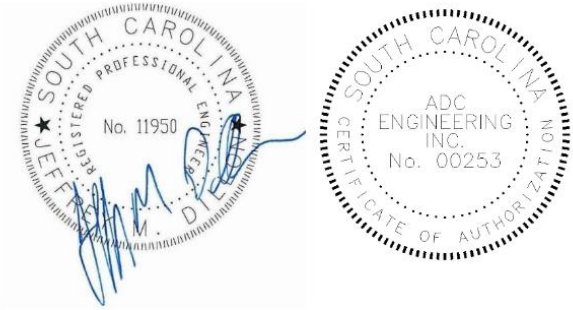
1. McMillan Pazdan Smith Architecture

B. Civil Engineer:

1. Campco Engineering

C. Structural Engineer:

1. ADC Engineering, Inc.



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DOCUMENT 00 31 32 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. Soil-boring data for Project, obtained by ECS , dated 04.11.2023 , is available for viewing as appended to this Document.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.

END OF DOCUMENT 00 31 32

SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under Owner's separate contracts.
4. Work restrictions.
5. Specification and Drawing conventions.

1.2 PROJECT INFORMATION

A. Project Identification: Fort Mill School District Alternative School Modular.

1. Project Location: 1599 Farm House Drive, Fort Mill, South Carolina.

B. Owner: Fort Mill School District, 2233 Deerfield Drive, Fort Mill, South Carolina.

1. Owner's Representative: Joe Romenick.

C. Architect: McMillan Pazdan Smith - Charlotte; 1422 South Tryon Street, Suite 700, Charlotte, North Carolina, 28203.

1. Architect's Representative: Mr. Cory Boudreau, McMillan Pazdan Smith Architecture.

D. Architect's Consultants: Architect has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Structural Engineer: ADC Engineering, Inc.
2. Electrical Engineer: Optima Engineering, PA.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 31 00 "Project Management and Coordination." for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. Place concrete pad, piers for modular class rooms. Relocate existing 8 modular classrooms from The Citadel. Hook up for electrical and mechanical and other Work indicated in the Contract Documents.
2. Owner is responsible for purchase/rental of the modular classrooms. Coordinate with Owner for executed contract and other paperwork for the units that will be moved and placed.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
   a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

B. Contractor's Responsibilities: The Work includes the following, as applicable:

1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
3. Receive, unload, handle, store, protect, and install Owner-furnished products.
4. Make building services connections for Owner-furnished products.
5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
6. Repair or replace Owner-furnished products damaged following receipt.

1.5 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 8:00 a.m. to 6:00 p.m., Monday through Friday, unless otherwise indicated.

1. On-Site Work Hours does not pertain to hauling of Modular Units. Arrangements shall be made with Authorities Having Jurisdiction for use of roadways.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Owner's property is not permitted.

F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 21 00 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-Sum Allowance.
2. Quantity Allowance.

1.2 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.3 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

C. Purchase products and systems selected by Architect from the designated supplier.

1.4 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.5 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.6 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.7 QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Lump Sum Cost Allowance: Include the sum of $10,000.00 as Plumbing Allowance to include inspection of existing water and sanitary connections of relocated modular unit. Reconnect or repair all damaged plumbing connections experienced during relocation. Provide necessary connections from the building to the adjacent water and sanitary utilities.

B. Allowance No. 2: Lump Sum Cost Allowance: Include the sum of $10,000.00 as Underground Raceway Allowance to include two 1-1/2-inch underground conduits from

the building of existing Sugar Creek Elementary School as shown on Sheet E101. Provide necessary pull boxes and pull string for future use.

C. Allowance No. 3: Quantity Allowance: Include 250 cu. yd. of unsatisfactory soil excavation and disposal off-site and replacement with satisfactory soil material from off-site, as specified on Drawings.

1. Coordinate quantity allowance adjustment with unit-price requirements in Section 01 22 00 "Unit Prices."

END OF SECTION 01 21 00

SECTION 01 22 00 - UNIT PRICES

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 administrative and procedural requirements for unit prices.

1.3 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.

1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with information indicated on Drawings.
2. Unit of Measurement: Per cubic yard of soil excavated, based on in-place surveys of volume before and after removal.
3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 01 21 00 "Allowances."

END OF SECTION 01 22 00

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

E. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment .

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.

2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Products list (preliminary if not final).
3. List of Contractor's staff assignments.
4. List of Contractor's principal consultants.
5. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
6. Report of preconstruction conference.
7. Certificates of insurance and insurance policies.
8. Performance and payment bonds.
9. Data needed to acquire Owner's insurance.

H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706.
5. AIA Document G706A.
6. AIA Document G707.
7. Evidence that claims have been settled.
8. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Project meetings.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.3 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.

2. Delivery and processing of submittals.
3. Progress meetings.
4. Preinstallation conferences.
5. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
   a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
   b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
2. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Owner name.
2. Owner's Project number.
3. Name of Architect.
4. Architect's Project number.
5. Date.
6. Name of Contractor.
7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: AIA Document G716or Software-generated form with substantially the same content as indicated above, acceptable to Architect.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow three days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:
    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal.
    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within five days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.

3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement .
    a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106 .

B. Web-Based Project Management Software Package: Use Architect's web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:
    a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.

i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Possible conflicts.
   i. Compatibility requirements.
   j. Time schedules.
   k. Weather limitations.
   l. Acceptability of substrates.
   m. Temporary facilities and controls.
   n. Space and access limitations.
   o. Regulations of authorities having jurisdiction.
   p. Testing and inspecting requirements.
   q. Installation procedures.
   r. Coordination with other work.

s. Required performance results.
t. Protection of adjacent work.
u. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.

9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

2. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Statement of compliance with specified referenced standards.
    d. Application of testing agency labels and seals.
    e. Availability and delivery time information.
4. For equipment, include the following in addition to the above, as applicable:
    a. Wiring diagrams that show factory-installed wiring.
5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    a. Identification of products.
    b. Notation of coordination requirements.
    c. Notation of dimensions established by field measurement.
    d. Relationship and attachment to adjoining construction clearly indicated.

C. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

E. Test and Research Reports:

1. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

1.7 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.8 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required , and return it.

1. Submittals by Web-Based Project Management Software: Architect will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will return without review submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 33 00

SECTION 01 56 39 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

1.2 DEFINITIONS

A. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

B. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings .

1.3 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

1. Mixture: Well-blended mix of 2 parts stockpiled soil to 1 part planting soil .

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements: Previously used materials may be used when approved by Architect.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart. Fencing is available in high-visibility orange color.
   a. Height: 48 inches .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

3.2 PREPARATION

A. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.3 TREE PROTECTION

A. Trunk Protection: Protect the trunk of each tree to remain as follows:

1. Wrap trunk with orange plastic construction fencing to 2 inches in thickness . Install 2-by-4-inch wood planks around trunk over wrap at maximum 3 inches apart. Minimum three planks per tree. Band together with no less than three steel bands stapled to the planks to hold them securely in place.
   a. Height: 48 inches .
   b. Trunk protection to remain in place no longer than 6 months .

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering protected areas except by entrance gates.

1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
2. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.

B. Maintain protection zones free of weeds and trash.

C. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 31 20 00 "Earth Moving" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

3.6 REGRADING

A. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.7 REPAIR AND REPLACEMENT

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

1. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
2. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

END OF SECTION 01 56 39

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Installation.
3. Cutting and patching.
4. Progress cleaning.
5. Starting and adjusting.
6. Correction of the Work.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by professional engineer, certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 01 31 00 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

C. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. 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.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 01 10 00 "Summary."

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

E. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete : Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
   b. Restore damaged pipe covering to its original condition.
3. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 MINOR REPAIRS

A. Where required and indicated by Architect, perform minor repairs and touch-up painting after units is properly set in place, including repair of joint sealants that have been compromised during moving.

3.7 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
   a. Use containers intended for holding waste materials of type to be stored.
4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only

cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Grade Beams and Tie Beams

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Contractor’s Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

B. Design Mixtures: For each concrete mixture.

1. Mix design submittals shall include test results and/or trial batch data that meet or exceed the required average compressive strength as required by ACI 301.
2. Trial batches shall consist of identical cementitious materials, fine and course aggregates, and admixtures to be used for mix design.
3. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
4. Design mixtures shall be coordinated with means of transport from point of delivery to point of placement. Allowances shall be made for changes in

properties due to means of transport (from point of delivery to point of placement).

5. For mixes to be transported (i.e. pumped) from point of delivery to point of placement include a statement as to the expected property changes (i.e. unit weight and air content) from point of delivery to point of placement.

C. Steel Reinforcement Shop Drawings:

1. Drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and bar supports for concrete reinforcement.
3. Identify all step footing locations and associated reinforcing
4. Identify and dimension all grade beam and tie beam construction joints
5. Include slab on grade construction joint reinforcement
6. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
    a. Location of construction joints is subject to approval of the Architect.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Installer Qualifications: The installer shall be experienced placing, finishing, curing, treating and protecting concrete equal in material, design and scope to that required for this project

C. Cartridge Injection Adhesive Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of anchors shall attend the training session. Training shall consist of a review of the complete process for the installation of the anchors and the use of proper equipment for drilling and installing the anchors, to include but not limited to:

1. Hole drilling procedure. Clarify acceptability of rotary hammer drilling and/or core drilling.
2. Hole drilling equipment
3. Type and diameter of drill bits
4. Hole preparation and hole cleaning technique
5. Hole cleaning equipment
6. Adhesive injection technique
7. Adhesive injection equipment
8. Adhesive curing requirements

D. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

E. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

F. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 318, “Building Code Requirements for Structural Concrete”.

H. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement:

1. Deliver, store, and handle steel reinforcement to prevent bending and damage.
2. Maintain reinforcement free of dirt and other deleterious materials.
3. Store reinforcing on dunnage or other supports up off of ground.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Typical Reinforcing Bars:

1. ASTM A 615/A 615M, deformed, Grade 60.

B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Concrete Brick, Standees, Bolsters, chairs, spacers, supplementary reinforcing steel and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place including measures for supporting and anchoring reinforcing intermediate and top layers of reinforcing. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. Concrete brick supports are limited to use in supporting the bottom mat of below grade foundation reinforcing steel. Concrete brick supports shall consist of solid units of unit strength equal to or greater than associated foundation concrete. Submit material test reports for approval.

C. Cartridge Injection Adhesive: A two part adhesive injection system for anchorage of new reinforcing steel to existing concrete construction.

1. Where adhesive manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect, provide the following or approved equal:

a. Hilt HIT RE 500 V3 Adhesive Anchorage System, ICC ESR-3814.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type I/II or Type III unless noted otherwise. Supplement with Fly Ash: ASTM C 618, Class F.

B. Normal-Weight Aggregates: ASTM C 33, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Coarse Aggregate

a. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
b. Class: Per ASTM C33 requirements for the concrete use and region of the project

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will 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 C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Accelerating Admixture: Non-Chloride, ASTM C494/494M, Type C.
4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: Provide one of the following.

1. Flexible lightweight, non-staining, polythelene, closed cell, non-absorbent, uv stable, compressible foam with a pre-scored removable strip to allow for clean and uniform sealant joint as follows:

    a. Density: ASTM D1751
    b. Compression: ASTM D3575

        1) 10% Deflection: 10 psi maximum
        2) 80% Deflection: 126 psi maximum

    c. Water absorption: ASTM D3575, 0.5% volume maximum

2. Resilient, flexible, non-extruding, asphalt-saturated cellulosic fiber with preformed cap to allow for clean and uniform sealant joint

    a. Density: ASTM D 1751

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Type V, for bonding freshly mixed concrete to hardened concrete.

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, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Compressive Strengths: Compressive strengths specified are as required for structural design. Compressive strength provided shall be increased as required by ACI 318 for exposure class or as required for specialty treatments or finishing of concrete (i.e. polishing)

C. Air Content: Shall be adjusted as required for exposure class, specialty treatments or finishing of concrete.

D. Exposure Class: Unless noted otherwise in drawings or specifications concrete shall be considered exposure class F0, S0, W0 and C0.

E. Coordination with means of transport (from point of delivery to point of placement):

1. Design mixtures shall be coordinate with means of transport from point of delivery to point of placement. Allowances shall be made in the mix design for changes in properties due to means of transport (from point of delivery to point of placement). Specifically an allowance shall be made for loss of air entrainment due to transport methods (i.e concrete pump) when air entrainment is explicitly specified or where air entrainment is used as part of achieving lightweight concrete.

2. Coordinate with schedule of special inspections for instances in which concrete properties are to be explicitly confirmed at point of placement.

F. Admixtures: Use admixtures as noted in mix design and according to 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, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use accelerating admixture in concrete as required for cold weather conditions.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.

2. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
3. Exposure Classes:

    a. Freeze/Thaw Exposure: F0
    b. Sulfate Exposure: S0
    c. Water Contact Exposure: W0
    d. Corrosion Exposure: C0

B. Grade Beams and Tie Beams: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Dry Unit Weight: 145 lb/cu. ft. plus or minus 3 lb/cu. ft.
3. Comply with any additional requirements for Mass Concrete Placements as occur.
4. Exposure Classes:

    a. Freeze/Thaw Exposure: F0
    b. Sulfate Exposure: S0
    c. Water Contact Exposure: W0
    d. Corrosion Exposure: C0

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. Unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305 has been submitted and approved comply with the following:
    a. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes.
    b. When air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Smooth-formed finished surfaces: Class A, 1/8 inch
2. Rough-formed finished surfaces: Class D, 1 inch

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Anchor rods and embeds shall be securely fastened in formwork prior to placing concrete, and concrete vibrated around the anchor or embed to ensure proper flow of concrete around anchors and embeds.
3. Anchor rod sleeves (where required) shall be accurately located and fastened in formwork prior to placing concrete.
4. Wet setting of anchor rods and embeds is not permitted.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work 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.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. 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 would reduce bond to concrete.

C. Anchorage of reinforcement into hardened concrete using cartridge injection adhesive anchors shall only be used where specifically indicated on plans or with written direction from the Engineer of Record for a specific location.

D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Foundation reinforcing steel may be supported on solid concrete brick units of strength equal to or greater than foundation concrete.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Welded Wire Reinforcement:

1. Install welded wire reinforcement in longest practicable lengths
2. Locate welded wire reinforcement in top 1/3 of slab on grades unless noted otherwise
3. Locate welded wire reinforcement at mid-depth of concrete slab thickness over deck flutes unless noted otherwise.
4. Lap edges and ends of adjoining sheets at least one mesh spacing plus 2”, but not less than 6”. Lace overlaps with wire.
5. Slabs on Grade 4” or less in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic

    a. Alternately, welded wire reinforcement may be placed on grade and “hooked”/pulled to the proper location
    b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.

6. Slabs on Grade greater than 4” in thickness: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic

    a. Placement of welded wire reinforcement on grade and “hooked”/pulled up into slab as concrete is placed is not permitted.
    b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.

7. Elevated slabs: Support welded wire reinforcement on chairs, bolsters or bar supports spaced to minimize sagging, and as required to support construction traffic

    a. Alternately, welded wire reinforcement may be placed on grade and “hooked”/pulled to the proper location
    b. Placement of welded wire reinforcement after placement of concrete and “walking in” is not permitted.

3.5 CARTRIDGE INJECTION ADHESIVE

A. Where manufacturer recommends the use of special tools for installation of anchors, such tools shall be used.

B. All facets of hole drilling, hole cleaning, anchor installation, anchor torqueing shall be in strict accordance with the ICC-ESR report and manufacturer's data.

C. Drill holes perpendicular to substrate surface.

D. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits as indicated in the ICC-ESR report.

E. Drill bits and core bits shall be of diameters indicated in the ICC-ESR report.

F. All holes shall be cleaned with compressed air to remove all drilling dust and other deleterious substances.

G. Remove water from holes to attain a surface dry condition unless specifically permitted otherwise by ICC-ESR report.

H. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete has achieved full design strength.

I. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

J. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

K. Follow manufacturer recommendations to ensure proper mixing of adhesive components.

L. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.

M. Remove excess adhesive from the surface.

N. Shim reinforcement with suitable device to center the reinforcement in the hole.

O. Do not disturb or load reinforcment before manufacturer specified cure time has elapsed.

P. Observe manufacturer recommendations with respect to installation temperatures.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Provide supplemental reinforcing and/or smooth dowels where indicated at joints.
4. Strip bulkheads from footings, beams, grade beams, tie beams, and slabs and roughen surface of concrete to a minimum 1/4" amplitude while concrete is still plastic.
5. Form keyed joints unless indicated otherwise. Embed keys at least 1-1/2 inches into concrete unless noted otherwise.
6. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
7. Locate joints in slabs on steel deck as follows:

    a. Joints parallel to joists (perpendicular to girders) shall be located at the midpoint between two adjacent joists.
    b. Joints parallel to girders (perpendicular to joists) shall be located at the midpoint of two adjacent girders.
    c. Stagger and offset joints as required to meet the requirements.

8. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
9. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
10. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and as follows.

1. Do not add water to concrete unless the batched water is specifically noted as less than the mix design and is indicated as such on the batch ticket.
2. Do not add more water than the amount of withheld water which is specifically identified on the batch ticket.
3. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

D. 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Concrete placed over metal deck shall be placed and screeded level and flat to the specified tolerances, maintaining at least the minimum specified slab thickness as shown on drawings. The contractor shall increase slab thickness as required to compensate for metal deck deflection, residual beam camber and beam deflection in order to achieve a level and flat floor within the specified tolerance.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. 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.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 305.1 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement unless a detailed hot weather concrete plan incorporating the recommendations of ACI 305.1 has been submitted and approved. At no time shall concrete temperature exceed 95 deg F at time of placement.

2. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete coordinate with Architectural drawings and specifications.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Foundations:

1. Protect top sides of footings to receive masonry or concrete construction from dirt and debris.
2. Excavations:

    a. Do not allow excavations directly adjacent to or beneath footings to the absolute greatest extent possible.
    b. Where excavations must occur beneath in place footings or slabs the area shall be careful excavated as to not damage structural elements. The area shall be backfilled and compacted at the end of the work day.
    c. Areas excavated below footings shall be backfilled with Controlled Low-Strength Material.
    d. Areas excavated adjacent to and at or below footing elevation shall be backfilled with Controlled Low-Strength Material unless the area is large enough to be backfilled with control fill in lifts attaining proper compaction between lifts.

F. Cure concrete according to ACI 308.1, as follows:

1. 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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments or polished finish.
    b. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. 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 will not interfere with bonding of floor covering used on Project.

3.11 CONCRETE REPAIRS

A. Where deficient concrete is identified on the job all repairs shall be subject to the EOR and AOR approval.

B. The contractor shall be responsible for enlisting a concrete repair specialists with no less than 5 years of documented concrete repair service and having repaired deficient conditions similar to those identified on no less than 5 projects in the previous five years.

C. The contractor and repair specialists shall prepare a narrative of the proposed repair including detailed methods and material, and submit for EOR approval prior to commencing with repairs.

D. Where repair of deficient work is to remain exposed, the deficient work shall be removed and replaced as directed by the EOR.

3.12 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 in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 033000

SECTION 042200 - CONCRETE UNIT 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:

1. Concrete masonry units.
2. Mortar
3. Grout.
4. Steel reinforcing bars.
5. Masonry joint reinforcement.
6. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 03 Section Division 05 Section "Cast-in-Place Concrete" for reinforcing steel dowels for anchoring concrete unit masonry to cast-in-place concrete.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Contractor’s Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

a. Show elevations of all reinforced walls including reinforcing per typical details for all openings including but not limited to openings for ductwork and piping.
b. Dowels shall match typical wall reinforcing unless noted otherwise.
c. Dowels shall extend a lap distance above finished floor, unless top of footing is more than typical bar lift below finished floor. In such an instance dowel shall extend a lap distance out of footing.
d. Coordinate bar lift detailing with sequencing requirements of part 3 of this specification section.
e. Layout cmu control joints per contract documents and show associated typical reinforcing.
f. General Contractor shall coordinate all necessary openings in masonry walls with all subcontractors and shall provide information to reinforcing steel detailer for preparation of shop drawings.
g. Where above the ceiling coordination drawings are a project requirement the coordination drawings shall be provided to the reinforcing steel detailer to aid in developing elevation of reinforced walls.

C. Design Mixtures:

1. Grout: For each type of grout

a. Indicate amounts of mixing water to be withheld for later addition at Project site.
b. Mix design submittals shall include test results and/or trial batch data that meet or exceed the required average compressive strengths required by ACI 301. In accordance with ASTM C476 all testing shall be completed per ASTM C1019.
c. Trial batches shall consist of identical cementitious materials, fine and course aggregates, and admixtures to be used for mix design.
d. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Masonry Installer: A single, experienced firm, or an approved joint venture, specializing in masonry construction with a minimum five- year record of successful completion of projects of similar scope, capable of providing labor and material and performance bonds for its portion of the Work that are acceptable to the Owner. Installer shall furnish all required materials and equipment and perform the work of this Section with its own regular employees.

1. The masonry supervisor/foreman shall have had at least 5 years of experience with at least 5 projects of similar size and nature; he shall not act as or become a production worker.

2. The lead/crew chief masons shall have had at least 3 years of experience with at least 5 projects of similar size and nature;
3. Installer shall have experienced masonry superintendent and crew chiefs on site supervising the work whenever work is in progress.
4. Contractor's Own Forces: Contractor may utilize own forces for work of this Section when Contractor and Contractor's masonry superintendent and crew chiefs meet the above qualifications.

C. Post Installed Structural Anchor Installer: See specification section 050520 for requirements

D. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

E. 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.

F. Limitations on Aggregates: For concrete masonry units containing recycled material or post-industrial waste, provide units free of impurities that will cause rusting, staining or popouts and with a record of successful in-service performance in conditions similar to those expected at Project site.

1. Ferrous material shall be removed by magnetic separation.
2. Aggregates shall contain no combustible materials.
3. Aggregates shall be graded and supplied in consist graduations from batch to batch.
4. Material shall be tested according to the following:

    a. ASTM C40: Organic Impurities in Fine Aggregates for Concrete.
    b. ASTM C 136: Sieve Analysis of Fine and Coarse Aggregate.
    c. ASTM C 641: Staining Materials in Lightweight Concrete Aggregates.
    d. ASTM C 151: Autoclave Expansion of Hydraulic Cement (for popouts.)

G. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

H. Grout Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design grout mixtures.

I. Daily Log: Maintain a daily log of masonry work in progress for inspection by Owner, Architect, Special Inspector or Authority Having Jurisdiction.

1. Indicate on small scale plans where masonry was erected.
2. Indicate on small scale plans where masonry was grouted.
3. Identify crew and assigned work area.
4. Certify that the following tasks have been performed.

a. Inspection of construction and verification of compliance with requirements as indicated in schedule of special inspections.
b. Daily Cleaning.

1.6 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 contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and 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.

1.7 PROJECT 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.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. 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.

D. 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 ACI 530.1/ASCE 6/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.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 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, bond beams and other special conditions.

B. Cell Layout:

1. All block shall be of standard two cell or open end configuration.
2. All block shall be configured such that it allows for both of the following:

a. Placement of reinforcing as indicated with not less than 1/2" clear grout cover between the bar and the block.
b. For the required bonding pattern the block will provide a minimum 3 inch by 3 inch continuous vertical column to receive grout.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Density Classification:
   a. Lightweight unless otherwise indicated.

3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

2.3 MORTAR AND GROUT 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.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: Not Permitted

E. Mortar Cement: ASTM C 1329.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

G. Aggregate for Grout: ASTM C 404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.4 REINFORCEMENT

A. Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Finish: Hot Dip Galvanized
2. Wire Size for Side Rods: W1.7 or 0.148-inch diameter.
3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.

4. Wire Size for Veneer Ties: W1.7 or 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.

2.5 TIES AND ANCHORS

A. 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 A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M. Hot-dip galvanized to comply with ASTM A 153/A 153M

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer or anchored masonry.

C. Rigid Anchors: Fabricate from ASTM A 36 steel bars 1-1/2 inches wide by 1/4 inch thick by length required, with ends turned up 2 inches in alternate directions.Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Vertical Reinforcing Bar Positioners: Custom fabricated wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding vertical reinforcing bars in proper location of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication.

1. Provide units with two loops for masonry walls indicated to have a single vertical reinforcing bar at each grout spacing.

   a. Loop layout shall allow for placement of vertical reinforcing in center of cmu wall thickness unless noted otherwise

2. Provide units with four loops or a pair of units with two loops for masonry walls indicated to have two vertical reinforcing bars at each grout spacing.

   a. Provide custom fabricated positioners with loop layout to allow for placement of vertical reinforcing as indicated in the contract documents.

2.7 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.8 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 or mortar cement mortar unless otherwise indicated.
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.

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. Preblended, Dry Grout Mix: Furnish dry grout ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

D. Mortar for Unit Masonry: Provide "Type S" mortar complying with ASTM C 270, Proportion or Property Specification unless indicated otherwise.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 as follows:

   a. 28-day compressive strength of 3000 psi unless noted otherwise.
   b. Provide grout with a slump of 8 to 11 as measured according to ASTM C 143/C 143M.

3. Ready-Mixed Grout: Measure, batch, mix, and deliver grout according to ASTM C 476, and furnish batch ticket information.

   a. Slump shall be adjusted on site as necessary, and grout shall be re-mixed at mixing speed for at least one minute before discharging to achieve the desired consistency.

4. Project-Site Mixed Grout: Mix preblended, dry grout mix according to ASTM C 476.

   a. Mix in a mechanical mixer for a minimum of 5 minutes with sufficient water to achieve the desired consistency.
   b. Hand mixing of grout is not permitted

c. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

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 work.
2. Verify that foundations are within tolerances specified.
3. Verify that foundations are "broom" clean and free of debris or other laitance that may compromise mortar bond.
4. Verify that reinforcing dowels are properly placed and extend to the proper elevation.

B. Before installation, examine rough-in and built-in construction for electrical, mechanical, piping and other systems to identify locations of built in construction..

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 the 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.

1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Comply with the construction tolerances in ACI 5301.1 unless modified herein.

B. 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.

C. 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 feet, 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 feet , 1/4 inch in 20 feet, or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, 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 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet , 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 feet, 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.

D. 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 for typical bed joints.
2. For bed joints on foundations the minimum thickness shall be 1/4 inch and the maximum thickness shall be 3/4 inc.
3. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
4. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
5. 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.]

6. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 MORTAR BEDDING AND JOINTING

A. General: Prepare mortar in accordance with current Portland Cement Association publications.

B. Prepare fresh mortar at the rate it will be used, in order to maintain consistent color and workability. Do not use mortar that has stiffened because of hydration. Discard when not used within the time recommended by mortar manufacturer or PCA publications, whichever is shorter. Retemper mortar carefully to avoid color changes, no more than twice per batch.

C. Measure mortar materials using cubic foot measuring box or other approved container of known volume, of size appropriate for operation. Use a consistent ratio of water to mortar materials, within the range recommended by the mortar manufacturer's written instructions.

D. Lay hollow CMUs as follows:

1. Only lay cmu on foundations after they have achieved a "broom" clean condition and are free of debris or other laitance that may compromise mortar bond.
2. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
3. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
4. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
5. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
6. With head joints filled to a minimum thickness equal to the face shell of the unit on both faces of the unit.

E. 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.

F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

G. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

H. Immediately after placing a course of masonry clean mortar drippings and fins from cells to receive reinforcing. Care shall be taken to collect the loose material and remove it from the cell and not allowing it to collect at the bottom of the cell.

3.5 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602 and as follows:

1. Center all vertical reinforcing steel on the thickness of the concrete masonry unit unless noted otherwise.
2. Bar positioners must be anchored in place with mortar.
3. Sequencing:

    a. Reinforcing steel from previous grout lift extends a lap distance out of hardened grout.
    b. No additional reinforcing is placed, and additional masonry is laid up, but not exceeded the grout pour height limit.
    c. Reinforcing bar positioner is placed in the bed joint of the second course of additional masonry, and below the last bed joint of additional masonry with additional bar positioners installed such that spacing does not exceed 48 inches on center
    d. The cells of additional masonry are cleaned of mortar droppings and mortar fins.
    e. A lift of reinforcing steel is dropped into the previously laid masonry using the bar positioners to ensure proper location. The reinforcing steel shall extend above the proposed grout pour height by a minimum of one splice distance.
    f. The grout lift is placed and consolidate.
    g. The sequence is repeated.

4. Where a reinforced cell is noted to have the vertical reinforcing offset from the center of the concrete masonry unit then provide special two loop bar positioners to locate each vertical bar and the associated splice bar per the contract documents.

    a. Alternately a two loop bar positioner may be installed rotated parallel to the face shells to locate the vertical bar and the associated splice bar per the contract documents.

5. Where a reinforced cell is noted to have two vertical bars provide special four loop bar positioners to locate each vertical bar and the associated splice bar per the contract documents.

a. Alternately a pair of two loop bar positioners may be installed rotated parallel to the face shells to locate each vertical bar and the associate splice bar per the contract documents.

6. A minimum of 1” clear shall be maintained between pairs of parallel bars occurring in the same vertical cell, lintel or bond beam.
7. A minimum of 1” clear shall be maintained between vertical bars or pairs of vertical bars and , piping or other embeds occurring in the same vertical cell.
8. A minimum of ½” shall be maintained between any reinforcing bar and the adjacent masonry unit.
9. Wet setting of reinforcing steel into previously placed grout is not permitted.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Prior to grouting all grouted cells shall be inspected to ensure cells are free of loose mortar droppings or debris.

   a. All debris and mortar droppings shall be removed.
   b. All hardened mortar or mortar fins protruding more than 1/2 inch into cell shall be removed.

2. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for grout properties and minimum grout space.
3. Limit height of vertical grout lifts and grout pours to not more than 60 inches.
4. Grout all courses of lintels and beams in one continuous operation for the full height of the lintel or beam. Do not allow cold joints in lintels and beams.
5. Grout lifts shall be terminated at top of walls shall be carefully consolidated to ensure grout is cured flush to top of masonry, and provides solid bearing beneath all bearing plates.
6. Grout lifts terminating at bond beams, except at top of wall shall stopped 1/2" down from top of bond beam
7. Typical grout lifts, not terminating at bond beam or top of wall shall be terminated a minimum of 1 1/2", but not more than 3" below a bed joint.
8. All grout lift terminations shall be coordinate with reinforcing steel layout to ensure proper lap distance of reinforcing steel. Grout pours shall not be terminated anywhere along the length of the splice.
9. All grout shall consolidated using internal vibration with a pencil type vibrator.

   a. Consolidate grout in each cell or bond beam immediately after placement. Top of bond beam or cell to desired height after initial consolidation.
   b. Reconsolidate grout in each cell or bond beam after initial water loss and settlement has occurred approximately 10 minutes after initial consolidation. Top of bond beam or cell to desired height after reconsolidation.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 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.

3.8 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.

END OF SECTION 042200

SECTION 050520 - POST INSTALLED STRUCTURAL ANCHORS

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. Wedge anchors
2. Cartridge injection adhesive anchors

B. This specification section is only intended for use when specifically required by the drawings or other referencing specifications and structural applications. This section is not intended for use in non-structural applications or where not specifically referenced by the drawings or other specification sections.

C. Related Sections include the following:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.

1.3 PERFORMANCE REQUIREMENTS

A. The basis of design products are as specified in this specification or the contract documents. Product substitutions must have capacities equal to or greater than values calculated for each specific condition calculated when calculated using the data in the referenced ESR report and in accordance with the appropriate design procedure and standards required by the building code. See requirements for substitution submittals.

1.4 DEFINITIONS

A. Post Installed Structural Anchors: Anchors supporting and/or anchoring structural elements of the building which are installed into hardened concrete or masonry and that are specified in the contract documents or performance based shop drawing design submittals for structural elements.

B. Wedge Anchors: A torque-controlled anchor, with an integral cone expander and single piece steel expansion clip providing 360-degree contact with the base material while

not requiring oversized holes for installation and an impact section to prevent thread damage with required nuts and washers.

C. Cartridge Injection Adhesive Anchors: An anchor system consisting of rod insert, nut, washer and a cartridge type, two-component polymer or hybrid mortar adhesive system dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

1.5 SUBMITTALS

A. Contractor's Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

   a. Coordinate meeting with individual preinstallation conferences for the following
   b. Structural Steel Framing
   c. Cold-Formed Metal Framing
   d. Rough Carpentry

B. Installer Qualifications: The installer shall be experienced in installing anchors equal to type, and into the substrate material required for this project

C. Installer Training: Conduct a thorough training session with the manufacturer's representative. Each individual responsible for the installation of anchors shall attend the training session. Training shall consist of a review of the complete process for the installation of the anchors and the use of proper equipment for drilling and installing the anchors, to include but not limited to:

   1. Hole drilling procedure. Clarify acceptability of rotary hammer drilling and/or core drilling.
   2. Hole drilling equipment
   3. Type and diameter of drill bits
   4. Hole preparation and hole cleaning technique
   5. Hole cleaning equipment
   6. Adhesive injection technique
   7. Adhesive injection equipment
   8. Anchor rod, nut and washer material requirements and associated cleaning requirements
   9. Anchor and Anchor rod installation
   10. Anchor tightening
   11. Adhesive curing requirements

D. Certifications: All anchors shall have an ICC ESR Evaluation report indicating conformance with the current applicable Acceptance Criteria for the building code applicable to the project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Keep anchors, rod materials, nuts and washers in manufacturer's packaging with label intact until needed for use.

B. Keep anchors free of dirt and debris.

C. Store anchors in a clean dry area

D. Protect anchors from corrosion and deterioration.

E. Store anchors and adhesives in strict accordance with manufacturer's requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nuts: Having a proof load stress equal or greater than the minimum tensile strength of the associated anchor where type and strength is not specifically indicated by anchor or adhesive manufacturer.

B. Washers: Of type and material compatible with nuts unless specifically indicated by anchor or adhesive manufacturer.

C. Plate Washers: Provide ASTM A 36 plate washers of size and configuration specifically indicated.

2.2 CORROSION RESISTANCE

A. Anchors and Anchor Bodies

1. Uncoated Carbon Steel: Carbon steel anchors uncoated and free from oil, lubricants and other deleterious substances.Acceptable for use as follows:

a. Interior dry conditions

2. Zinc Plated: Zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1) Acceptable for use as follows:

a. Interior dry conditions

3. Hot Dip Galvanized: Carbon steel anchors with hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:

a. Interior dry conditions
b. Exterior conditions
c. Anchoring galvanized steel elements

4. Stainless Steel: AISI Type 316 stainless steel and complying with ASTM F 593. Acceptable for use as follows:

a. Anchoring treated lumber elements
b. Anchoring stainless steel elements
c. Anchoring aluminum elements or in contact with aluminum elements.

B. Nuts

1. Uncoated carbon steel: Acceptable for use as follows:

a. With Uncoated Anchors

2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:

a. With Zinc Plated Anchors
b. With Hot Dip Galvanized Anchors

3. Stainless Steel: ASTM F594. Acceptable for use as follows:

a. With Stainless Steel Anchors

C. Washers

1. Uncoated carbon steel: Acceptable for use as follows:

a. With uncoated anchors

2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:

a. With Hot Dip Galvanized Nuts

3. Stainless Steel: AISI Type 316 stainless steel. Acceptable for use as follows:

a. With Stainless Steel Nuts

D. Plate Washers:

1. Uncoated carbon steel: Acceptable for use as follows:

a. With Uncoated Nuts

2. Hot Dip Galvanized: Hot-dipped galvanized in accordance with ASTM A 153. Acceptable for use as follows:

a. With Hot Dip Galvanized Nuts

2.3 WEDGE ANCHORS

A. Provide anchors with length identification markings conforming to ICC-ES AC01 or ICC-ES AC193 as appropriate based on the anchor substrate..

B. Size: As indicated on drawings

C. Embedment depth: As indicated on the drawings but not less than the manufacturer's documented minimum embedment depth. Where not specifically indicated use manufacturer's minimum documented embedment depth.

1. Embedment depth is from surface of concrete or masonry. Anchor lengths and extent of threads shall account for embedment depth, connected elements, plate washers, washers, nut and appropriate stick thru.

D. Concrete Anchors:

1. Anchors shall be tested in accordance with ACI 355.2 and the most recent issue of ICC-ES AC193 including the following:

   a. All mandatory testing
   b. Shear and tension in cracked concrete.
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 318 Chapter 17
3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:

   a. Hilti Kwik Bolt TZ with nut and washer, of required finish, ICC ESR-1917
   b. Approved equal (See substitution requirements)

E. Masonry Anchors:

1. Anchors for masonry shall be tested in accordance with most recent edition of ICC-ES AC01 including the following

   a. All mandatory testing
   b. Seismic tension and shear
   c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 530
3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:

   a. Hilti Kwik Bolt 3 with nut and washer, of required finish, ICC ESR-1385.
   b. Approved equal (See substitution requirements)

2.4 CARTRIDGE INJECTION ADHESIVE ANCHORS

A. Provide anchors with length identification markings conforming to ICC-ES AC58 or ICC-ES AC308.

B. Size: As indicated on drawings

C. Embedment depth: As indicated on the drawings but not less than the manufacturer's documented minimum embedment depth. Where not specifically indicated use manufacturer's minimum documented embedment depth.

1. Embedment depth is from surface of concrete or masonry. Anchor lengths and extent of threads shall account for embedment depth, connected elements, plate washers, washers, nut and appropriate stick thru.

D. Adhesive: Two component epoxy or two component hybrid system.

E. Concrete Anchors:

1. Anchors shall be tested in accordance with the most recent issue of ICC-ES AC308 including the following:

    a. All mandatory testing
    b. Shear and tension in cracked concrete.
    c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 318 Chapter 17 as amended by the specific design provisions of ICC-ES AC308
3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:

    a. Rods, washers, and nuts of required finish with Hilti HIT RE 500 V3 Adhesive Anchorage System for anchorage to concrete, ICC ESR-3814.
    b. Rods
        1) Carbon Steel Rods: ASTM A193 B7 coated as required for use
        2) Stainless Steel Rods: ASTM F593, CW

    c. Approved equal (See substitution requirements)

4. Where Hilti HIT-HY 200, ICC ESR-3187 system is specifically indicated in contract documents or approved performance based shop drawings submittal anchors shall be as follows:

    a. For anchors 3/8" to 3/4" diameter: HIT-Z Standard or HIT-Z-R SS rods, washers, and nuts of required finish.
    b. Approved equal (See substitution requirements)

F. Masonry Anchors:

1. Anchors for masonry shall be tested in accordance with most recent edition of ICC-ES AC58 including the following

    a. All mandatory testing
    b. Seismic tension and shear
    c. Critical and minimum edge distances and spacing

2. Anchors design shall be in accordance with ACI 530
3. Where not specifically indicated otherwise in contract documents or approved performance based shop drawings submittal anchors shall be as follows:

    a. Grouted Masonry: HAS-E Standard or HAS SS rods, washers, and nuts of required finish with Hilti HIT HY 270 Adhesive Anchorage System for anchorage to masonry, ICC ESR-4143.

    b. Approved equal (See substitution requirements)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
2. Installation constitutes acceptance of existing conditions and responsibility of satisfactory performance.

3.2 INSTALLATION, GENERAL

A. Corrosion Resistance: Care shall be taken to ensure an anchor and associated accessories of the proper material and associated corrosion resistance are used for the specification application. See corrosion resistance requirements above.

B. Where manufacturer recommends the use of special tools for installation of anchors, such tools shall be used.

C. Match mark and drill, match drill or use other methods to ensure anchors are properly located.

D. Do not adjust anchor location after installation. Coordinate with EOR for modifications to connected element where anchors are incorrectly located.

E. All facets of hole drilling, hole cleaning, anchor installation, anchor torqueing shall be in strict accordance with the ICC-ESR report and manufacturer’s data.

F. Drill holes perpendicular to substrate surface.

G. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits as indicated in the ICC-ESR report.

H. Drill bits and core bits shall be of diameters indicated in the ICC-ESR report.

I. All holes shall be cleaned with compressed air to remove all drilling dust and other deleterious substances.

J. Remove water from holes to attain a surface dry condition unless specifically permitted otherwise by ICC-ESR report.

K. Base Material Strength: Unless otherwise specified, do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

L. Embedded Items: Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items. Notify the Engineer if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and telecommunications conduit, and gas lines.

M. Perform anchor installation in strict accordance with manufacturer instructions and ICC-ES report.

N. Anchors shall be installed perpendicular to the substrate face within plus or minus 5 degrees unless specifically permitted otherwise by ICC-ESR report.

O. Install plate washers where specifically indicated or where connected elements have oversized holes.

P. Install a round washer under nuts. Round washers are in addition to plate washers where plate washers are required.

3.3 WEDGE ANCHORS

A. Protect threads from damage during anchor installation.

B. Set anchors to manufacturer’s recommended torque, using a torque wrench. Following attainment of 10% of the specified torque, 100% of the specified torque shall be reached within 7 or fewer complete turns of the nut. If the specified torque is not achieved within the required number of turns, the anchor shall be removed and replaced unless otherwise directed by the Engineer.

3.4 CARTRIDGE INJECTION ADHESIVE ANCHORS

A. Clean all holes per manufacturer instructions using manufacturer’s approved tools to remove loose material and drilling dust prior to installation of adhesive.

B. Inject adhesive into holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

C. Follow manufacturer recommendations to ensure proper mixing of adhesive components.

D. Sufficient adhesive shall be injected in the hole to ensure that the annular gap is filled to the surface.

E. Remove excess adhesive from the surface.

F. Shim anchors with suitable device to center the anchor in the hole.

G. Do not disturb or load anchors before manufacturer specified cure time has elapsed.

H. Observe manufacturer recommendations with respect to installation temperatures.

I. Hilti HIT-HY200 system anchors shall be installed using the Hilti Safe Set Technology.

1. For conditions using HAS rods the Hilti hollow drill bit and Hilt vacuum system shall be employed.

3.5 FIELD QUALITY CONTROL

A. Testing and Inspection: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Remove and replace misplaced or malfunctioning anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout. Anchors that fail to meet proof load or installation torque requirements shall be regarded as malfunctioning.

B. Galvanizing Repairs: Prepare and repair damaged galvanized coatings with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 050520

SECTION 05 51 36.10 - METAL STAIRS, RAMPS, AND RAILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fabricated metal stairs, ramps, and railing.

1.2 ACTION SUBMITTALS

A. Product Data: For fabricated metal stairs and ramps, including railings. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for components.

B. Shop Drawings: For fabricated metal stairs, ramps, and railings. Include plans, elevations, sections, details, attachments to other work, and field measurements.

C. Delegated Design Submittal: For fabricated metal stairs, ramps, and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with fabricated metal stairs and ramps by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fabricated metal stairs, ramps, and handrailing from single source from single manufacturer.

B. Basis-of-Design: Provide manufactured modular ramp system by Quick-Deck, Inc.; Aluminum Modular Platform System.

1. 137 Pine Forest Drive, Locust, NC 28097; 704-888-0327.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design fabricated metal stairs and railings.

B. Structural Performance of Stairs and Ramps: Fabricated metal stairs and ramps are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7:

1. Uniform Load: 40 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Railing Loads: Stairs and ramps are to withstand stresses resulting from railing loads in addition to loads specified above.
5. Deflection: Limit deflection of treads, landings, ramps, and framing members to L/360 but not to exceed 1/4 inch.

C. Structural Performance of Railings: Railings are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7:

1. Handrails and Top Rails of Guards:
    a. Uniform load of 50 lbf/ft. applied in any direction.
    b. Concentrated load of 200 lbf 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 applied horizontally on an area of 1 sq. ft..
    b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Fabricated metal stairs and ramps are to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

E. ADA Compliance: System shall comply with ICC ANSI 117.1-2017.

2.3 STAIRS, RAMPS, AND RAILINGS

A. Treads, Cast Metal: Cast aluminum treads and platforms with integral frames and legs.

1. Provide treads and platforms with abrasive surfaces.

B. Treads, Formed Metal Plate: Formed aluminum-plate treads and platforms as follows:

1. Tapered flanges without legs.
2. Aluminum-alloy, rolled tread-plate wearing surfaces.
3. Rubber wearing surfaces.

C. Railings: Uniformly bent to shape.

1. Space balusters less than 4 inches, clear.
2. Space intermediate rails less than 4 inches, clear.
3. Locate bottom rail so that a 6-inch- diameter sphere cannot pass between the stair and rail.
4. Hand Rail:
   a. 1-1/4- to 2-inch- OD round aluminum tubing.
5. Top Rail:
   a. 1-1/4- to 2-inch- OD round aluminum tubing.
6. Balusters:
   a. 5/8-inch- OD round aluminum tubing.
7. Intermediate Rails:
   a. Round aluminum tubing same size as top rail.

2.4 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported item unless otherwise indicated.

C. Aluminum Sheet and Plate: ASTM B209, Alloy 6061-T6.

D. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

E. Aluminum Pipe and Structural Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

F. Extruded-Aluminum Tubing: ASTM B221, Alloy 6063-T5/T52.

G. Aluminum Castings: ASTM B26/B26M, Alloy 319.0-F.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: For connecting stair components and for anchoring stairs to other construction, select fasteners of type, grade, and class required to produce connections capable of withstanding design loadings.

1. For aluminum, provide fasteners fabricated from Type 304 stainless steel.
2. For exterior locations, provide fasteners fabricated from Type 304 stainless steel.

B. 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.

C. Rubber Wearing Surfaces: Manufacturer's standard, 1/4-inch- thick, molded-rubber covering in pattern and color indicated or, if not indicated, as selected by Architect from manufacturer's standard colors and patterns.

2.6 FABRICATION

A. Assemble fabricated metal stairs, ramps and 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.

B. Cut, drill, and punch metals 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 work true to line and level with accurate angles and surfaces.

D. Fabricate connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

E. Cut, reinforce, drill, and tap as needed to receive hardware, screws, and similar items.

F. 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. Finish exposed welds to comply with NOMMA Guideline 1, "Joint Finishes," for Finish #2 - Completely sanded joint, some undercutting and pinholes okay.
5. Finish exposed surfaces smooth and blended and, except for fillet welds, so welded surface matches contours of adjoining surfaces.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.7 ALUMINUM FINISHES

A. Mechanical Finish: AA-M3x; sand top rails, handrails, and intermediate rails in one direction only, parallel to length of railing, with 120- and 320-grit abrasive. After installation, polish railings with No. 0 steel wool immersed in paste wax, then rub to a luster with a soft dry cloth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where needed for securing fabricated metal stairs and ramps to in-place construction; include threaded fasteners for concrete and masonry inserts, through bolts, lag bolts, wood screws, and other connectors as required.

B. Assemble fabricated metal stair and ramp components to comply with manufacturer's written instructions, with each component aligned and in correct relation to each other, securely anchored to supporting column and adjacent structure.

C. Do not cut, alter, or drill stair components in the field that do not fit properly. Return components that do not fit to manufacturer for adjustment.

D. Install fabricated metal stairs and ramps accurately in location, alignment, and elevation; level and plumb; and in accordance with manufacturer's written instructions.

E. Install fabricated metal stairs and ramps by welding to steel structure or to weld plates cast into concrete unless otherwise indicated.

F. Field Welding:

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 welded surface matches contours of adjoining surfaces.

3.2 PROTECTION

A. Protect finished tread surfaces during construction by covering with 1/2-inch- thick, plywood secured with plastic strapping or another nonmarring fastening method.

END OF SECTION 05 51 36.10

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

F. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber:

1. Boards: 19 percent.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
3. After treatment, redry dimension lumber to 19 percent maximum moisture content.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
2. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT TREATMENT

A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment is not to promote corrosion of metal fasteners.
2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being

subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber is to be tested according to ASTM D5664 and design value adjustment factors are to be calculated according to ASTM D6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.

1. Species:
   a. Southern pine or mixed southern pine; SPIB.

2.5 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:

1. Mixed southern pine or southern pine; SPIB.

C. Concealed Boards: 19 percent maximum moisture content and the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
2. For pressure-preservative-treated wood, use stainless steel fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

2.7 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Do not splice structural members between supports unless otherwise indicated.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet , apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Mildew-resistant joint sealants.
3. Latex joint sealants for interior use only.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Nonstaining silicone joint sealants.
2. Mildew-resistant joint sealants.
3. Latex joint sealants.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.3 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.4 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

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. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

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. Adfast.
   b. Pecora Corporation.
   c. Sika Corporation - Building Components.
   d. Tremco Incorporated.

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

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. Adfast.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Pecora Corporation.
   d. Sika Corporation - Building Components.
   e. The Dow Chemical Company.
   f. Tremco Incorporated.

2.4 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

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. Adfast.
   b. Pecora Corporation.
   c. Sherwin-Williams Company (The).
   d. Tremco Incorporated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, 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. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hinges.
2. Bored locks.
3. Mortise locks.
4. Lock cylinders.
5. Key lock boxes.
6. Operating trim.
7. Surface closers.
8. Wall- and floor-mounted stops.

1.2 ALLOWANCES

A. Door hardware is part of Door Hardware Allowance .

1.3 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site .

1. Conference participants must include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system, including, but not limited to, the following:
   a. Flow of traffic and degree of security required.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Hinges.
2. Mortise locks.
3. Mortise auxiliary locks.
4. Exit devices and auxiliary items.
5. Lock cylinders.
6. Key lock boxes.
7. Operating trim.
8. Surface closers.
9. Overhead stops and holders.
10. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each exposed product in each finish specified, in manufacturer's standard size.

1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Schedules: Final door hardware and keying schedule.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures, including excessive deflection, cracking, or breakage.
   b. Faulty operation of doors and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
   a. Exit Devices: Two years from date of Substantial Completion.
   b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 .

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:
   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
3. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
4. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 HINGES

A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
3. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Levers: Cast.
2. Escutcheons (Roses): Cast.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

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: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: ANSI/BHMA A156.2, Grade 1 , Series 4000.

G. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 1 ; stamped steel case with steel or brass parts; Series 1000.

2.5 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: ANSI/BHMA A156.29, Grade 1.

2.6 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

B. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Interchangeable .

2.7 KEYING

A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. No Master Key System: Only change keys operate cylinders.
   a. Provide three cylinder change keys.
2. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver .

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
   a. Notation: Information to be furnished by Owner.

2.8 KEY CONTROL SYSTEM

A. Key Lock Boxes: Designed for storage of two keys.

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. HPC, a Hudson Lock Company.
   b. Kidde; Carrier Global Corporation.
   c. Knox Company.

2.9 OPERATING TRIM

A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.

2.10 SURFACE CLOSERS

A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.11 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.

2.12 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 FINISHES

A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's 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. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.

2. Furnish permanent cores to Owner for installation.

E. Key Control System:

1. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

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.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer's Architectural Hardware Consultant is to examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 08 71 00

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. 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.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Lead Paint: It is not expected that lead paint will be encountered in the Work.

1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products indicated below or comparable product by one of the following:

1. Benjamin Moore & Co.
2. PPG Paints.
3. Pratt & Lambert.
4. Valspar Corporation (The).

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

C. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 01 60 00 "Product Requirements," and the following:

1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis-of-design product including published ratio of solids by volume, plus or minus two percent.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system to be 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, products to be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As selected by Architect from manufacturer's full range .

2.3 PRIMERS

A. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Primer, B28W2600 Series or comparable product.

2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Low Sheen: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series or comparable product.
2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish .

B. Interior, Latex, Eggshell: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series or comparable product.
2. Gloss and Sheen Level: Manufacturer's standard eggshell finish .

C. Interior, Latex, Semigloss: Pigmented, water-based paint for use on primed/sealed interior plaster and gypsum board, and on primed wood and metals.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series or comparable product.
2. Gloss Level: Manufacturer's standard semigloss finish .

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. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   a. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations 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 if any.

C. Clean substrates of substances that could impair bond of paints, 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 paint systems indicated.

D. 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.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, 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 painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Latex over Shop-Applied Quick-Drying Shop Primer System :
    a. Prime Coat: Quick-dry primer for shop application.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, semigloss .
2. High-Performance Architectural Latex System :
    a. Prime Coat: Shop primer specified in Section where substrate is specified.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Topcoat: Interior, latex, high-performance architectural coating, semigloss.

B. Gypsum Board Substrates:

1. Latex over Latex Sealer System :
    a. Prime Coat: Interior latex primer sealer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, eggshell .
2. Institutional Low-Odor/VOC Latex System :
    a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
    b. Intermediate Coat: Matching topcoat.
    c. Topcoat: Interior, latex, institutional low odor/VOC, eggshell .

END OF SECTION 09 91 23

SECTION 10 14 23 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs.
2. Room-identification signs.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Not less than 12 inches square, including corner.
2. Room-Identification Signs: Full-size Sample.
3. Field-Applied, Vinyl-Character Signs: Full-size Sample of characters on glass.
4. Exposed Accessories: Full-size Sample of each accessory type.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of finishes beyond normal weathering.
   b. Deterioration of embedded graphic image.
   c. Separation or delamination of sheet materials and components.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. APCO Graphics, Inc.
2. ASI Sign Systems, Inc.

3. Best Sign Systems, Inc.
4. InPro Corporation (IPC).
5. Mohawk Sign Systems.
6. Nelson-Harkins Industries.
7. Poblocki Sign Company, LLC.
8. Vomar Products, Inc.

B. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Indicated on Drawings.
2. Solid-Sheet Sign: Acrylic sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows:
   a. Thickness: As indicated.
   b. Surface-Applied Graphics: Applied photo image.
   c. Etched and Filled Graphics: Sign face etched or routed to receive enamel-paint infill.
   d. Inset, Cutout Characters: Sign face routed to receive push-through acrylic graphics slightly projecting from the sign panel..
3. Sign-Panel Perimeter: Finish edges smooth.
   a. Edge Condition: Square.
   b. Corner Condition in Elevation: Radius.
4. Mounting: Mechanically attached with concealed fasteners.
5. Surface Finish and Applied Graphics:
   a. Photo-Image Graphics: Manufacturer's standard multicolor, halftone or dot-screen image.
6. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.
7. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

C. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Indicated on Drawings.
2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
   a. Composite-Sheet Thickness: As indicated.
   b. Surface-Applied Graphics: Applied photo image.
   c. Subsurface Graphics: Slide-in changeable insert.
   d. Color(s): As selected by Architect from manufacturer's full range.
3. Sign-Panel Perimeter: Finish edges smooth.
   a. Edge Condition: Square.
   b. Corner Condition in Elevation: Radius.
4. Mounting: Mechanically attached with concealed fasteners.

5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner Furnish two blank inserts for each sign for Owner's use.

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 signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
   a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
   b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
   b. Faulty operation of valves or release levers.
2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Babcock-Davis.
   b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
   c. Kidde; Carrier Global Corporation.
   d. Larsen's Manufacturing Company.
   e. Nystrom, Inc.
   f. Potter Roemer LLC; a Division of Morris Group International.
2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.

B. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

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. Babcock-Davis.
   b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
   c. Kidde; Carrier Global Corporation.
   d. Larsen's Manufacturing Company.
   e. Nystrom, Inc.
   f. Potter Roemer LLC; a Division of Morris Group International.
2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
   a. Orientation: Vertical .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 10 44 16

SECTION 13 34 23.14 - FABRICATED CLASSROOM BUILDINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for moving and installation of an existing fabricated classroom buildings.

1. The existing modular building is manufactured by Vanguard Modular Building Systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For utility hookups and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Certificates: For equipment, accessories, and components, from manufacturer.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer or an authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 MODULAR UNITS

A. Prepare existing modular units for transportation. Obtain all permits for road transportation.

B. Investigate site where modulars will be placed. Notify Architect if conditions are not suitable.

C. Off-load modular units and set where indicated; coordinate with structural engineer drawings for tie-downs, straps, stabilizer plates, and anchors installations.

D. Inspection: Provide third-party inspector access to modular units.

2.2 ASSEMBLY DESCRIPTION

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.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fabricated classroom building shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the building will remain in place without separation of any parts when subjected to the seismic forces specified and the building will be fully operational after the seismic event."
2. Component Importance Factor is 1.5.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Combustion Characteristics: ASTM E 136.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine condition of the fabricated classroom building before installation for damage during transportation.

3.2 ERECTION

A. Fabricated Classroom Building: Comply with local code requirements and School District standards.

3.3 CONNECTIONS

A. Make utility connections.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the inspections.

B. Prepare test and inspection reports.

END OF SECTION 13 34 23.14

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Subsoil materials.
2. Topsoil materials.

1.2 DEFINITIONS

A. Backfill: Soil materials 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: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations.
   1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. 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 dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Rock Excavation, Trench: Late-model, track-mounted hydraulic excavator; equivalent to Caterpillar Model N, 235D LC; measured according to SAE J-1179.
   2. Rock Excavation, Mass: Late-model, track-mounted loader with a hydraulically operated power ripper; equivalent to Caterpillar Model No. D-8N, Heavy Duty; measured according to SAE J-732.
   3. This classification does not include materials such as loose rock, concrete, or other materials that can be removed by means other than drilling and blasting, but which for any reason, such as economic reasons, the Contractor chooses to remove by drilling and blasting.

I. 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.

J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

M. Unsatisfactory Soils: Soils located below the design subgrade elevation and in excess of the topsoil striping, which are determined unsatisfactory by the geotechnical engineer.

N. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from single source throughout Work.

B. Perform Work according to SCDHEC, SCDOT, and local municipality standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subsoil:

1. Satisfactory Soils:

a. Excavated and reused material, imported borrow, select or local borrow, structural.
b. Graded.
c. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
d. Plasticity index of 20 or less.
e. Maximum dry density of at least 90 pounds per cubic feet when tested by the Standard Proctor Method (ASTM D698).
f. Comply with ASTM D2487 Group Symbol GW, GP, ML, SW, SP, and SM.

B. Topsoil:

1. Satisfactory Soils:

a. Excavated and reused material.
b. Graded and single screened.
c. Free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
d. Comply with ASTM D2487 Group Symbol OH, PT, SM, and ML.

2. Satisfactory Soils:

    a. Imported borrow.
    b. Friable loam.
    c. Reasonably free of roots, rocks larger than ½ inch, subsoil, debris, large weeds, and foreign matter.
    d. Single screened.
    e. pH: 5.5 to 7.5.
    f. Inorganic Material: Minimum 4 percent and maximum 25 percent.
    g. Comply with ASTM D2487 Group Symbol OH, PT, SM, and ML.

2.2 SOURCE QUALITY CONTROL

A. Testing and Analysis:

1. Subsoil Material: Comply with ASTM D698.
2. Topsoil Material: Comply with ASTM D698.
3. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavation:

1. Excavate subsoil and topsoil from designated areas.
2. Strip topsoil to full depth of topsoil in designated areas.
3. Remove excess excavated materials, subsoil, and topsoil not intended for reuse from Site.
4. Remove excavated materials not meeting requirements for subsoil and topsoil materials from Site.

B. Stockpiling:

1. Stockpile excavated material meeting requirements for subsoil and topsoil materials.
2. Stockpile materials on Site at locations as designated by Engineer.
3. Stockpile in sufficient quantities to meet Project schedule and requirements.
4. Separate differing materials with dividers or stockpile apart to prevent intermixing of soil types or contamination.
5. Stockpile topsoil maximum 10 feet high.
6. Direct surface water away from stockpile to prevent erosion or deterioration of materials.
7. Stockpile hazardous materials on impervious material and cover to prevent erosion and leaching until they are disposed.

3.2 CLEANING

A. Stockpile:

1. Remove stockpile and leave area in clean and neat condition.
2. Grade Site surface to prevent freestanding surface water.

END OF SECTION 31 05 13

SECTION 31 05 16 – AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Coarse aggregate materials.
2. Fine aggregate materials.

1.2 SUBMITTALS

A. Product Data: Submit name of imported materials source.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout Work.

B. Perform Work according to SCDOT and local municipality standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Coarse Aggregate:

1. Comply with SCDOT standard.

2. Gravel:

a. Description: Coarse stone, crushed, gravel.
b. Washed Stone: Pit run, angular crushed, natural.
c. Quality: Free of shale, clay, friable material, and debris.
d. Grading:

1) Comply with ASTM C136/C136M and ASTM D2487; Group Symbol GW, GP, GM, and GC.

2) Percent Passing According to Sieve Size:

a) 2 Inches: 100.
b) 1 Inch: 95.
c) 3/4 Inch: 95 to 100.
d) 5/8 Inches: 75 to 100.
e) 3/8 Inches: 55 to 85.

f) No. 4: 35 to 60.
g) No. 16: 15 to 35.
h) No. 40: 10 to 25.
i) No. 200: 5 to 10.

3. Pea Gravel:

a. Description: Pea Gravel.
b. Stone: Natural and washed.
c. Quality: Free of clay, shale, and organic matter.
d. Grading:

1) Comply with ASTM C136/C136M and ASTM D2487; Group Symbol GM and GC.
2) Minimum Size: 1/4 inch.
3) Maximum Size: 5/8 inch.

B. Fine Aggregate:

1. Comply with SCDOT standard.

2. Sand:

a. Description: Natural river or bank sand**,** washed.
b. Quality: Free of silt, clay, loam, friable or soluble materials, and organic matter.
c. Grading:

1) Comply with ASTM C136/C136M and ASTM D2487; Group Symbol SW, SP, SM, and SC.
2) Percent Passing According to Sieve Size:

a) No. 4: 100.
b) No. 14: 10 to 100.
c) No. 50: 5 to 90.
d) No. 100: 4 to 30.
e) No. 200: Zero.

2.2 SOURCE QUALITY CONTROL (COORDINATE W/2.2, 2.3, & 2.4)

A. Testing and Analysis:

1. Coarse-Aggregate Material: Comply with ASTM C136/C136M and ASTM D698.
2. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM C136/C136M and ASTM D698.
3. If tests indicate materials do not meet specified requirements, change material and retest.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavation:

1. Excavate aggregate materials from Site locations as indicated and as specified in Section 312213 - Rough Grading, 312316 – Excavation, and 312316.13 - Trenching.
2. Remove excess excavated coarse-aggregate and fine-aggregate materials not intended for reuse from Site.
3. Remove excavated materials not meeting requirements for coarse aggregate and fine aggregate from Site.

B. Stockpiling:

1. Stockpile materials on Site at locations as designated by Engineer.
2. Stockpile excavated material meeting requirements for coarse-aggregate and fine-aggregate materials.
3. Stockpile in sufficient quantities to meet Project schedule and requirements.
4. Separate different aggregate materials with dividers or stockpile apart to prevent intermixing of aggregate types or contamination.
5. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
6. Stockpile unsuitable materials on impervious material and cover to prevent erosion and leaching until they are disposed.

3.2 CLEANING

A. Stockpile:

1. Remove stockpile and leave area in clean and neat condition.
2. Grade Site surface to prevent freestanding surface water.

END OF SECTION 31 05 16

SECTION 31 05 19.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Turf reinforcement mats (TRMs).
2. Nonwoven geotextile material.

1.2 SUBMITTALS

A. Product Data: Manufacturer information including tensile strength, elongation, thickness, UV resistance, and other material specifications.

B. Shop Drawings: Fabric layout, seam locations, and overlap details in installation drawings.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

D. Manufacturer Instructions: Installation requirements, including storage and handling procedures.

E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of geotextile material, including placement depth.

1.4 QUALITY ASSURANCE

A. Perform Work according to governing agency standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM D4873.

B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 TRM

A. Manufacturers:

1. Furnish materials according to governing agency standards, or as directed in plans.

2.2 NONWOVEN GEOTEXTILE MATERIALS

A. Manufacturers:

1. Furnish materials according to governing agency standards.

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material.

3.2 PREPARATION

A. Subgrade Material and Compaction Requirements: As specified in Section 312316.13 - Trenching and 312323 - Fill.

3.3 INSTALLATION

A. Geotextile Material:

1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.

2. Ensure that material is in direct contact with subgrade.
3. Orientate with long dimension of each sheet parallel to direction of slope.
4. Minimum Unseamed Joints Overlap: 12 inches.

B. Securement Pins:

1. Insert through geotextile midway between edges of overlaps and minimum 2 inches from free edges.
2. Minimum Spacing:

    a. Slopes Steeper than 3 Horizontal on 1 Vertical: 24 inches o.c.
    b. Slopes 3 Horizontal on 1 Vertical to 4 Horizontal on 1 Vertical: 3 feet o.c.
    c. Slopes Flatter than 4 Horizontal on 1 Vertical: 5 feet o.c.

3. Ensure that washer bears against geotextile.

C. Seams:

1. Minimum Seamed Joints Overlap: 18 inches at longitudinal and transverse joints.
2. Seams across Slope: Lap upper panel over lower panel.
3. Sewn Seams:

    a. Continuously sew seams on slopes steeper than 1 vertical on 2 horizontal.
    b. Stitch Type: As recommended by geotextile manufacturer.
    c. Tie off thread at the end of each seam to prevent unraveling.

4. Thermal Seams:

    a. As recommended by geotextile manufacturer.
    b. Comply with ASTM D4886.

D. Penetrations: As indicated and recommended by geotextile manufacturer.

E. Repairing Damaged Geotextiles:

1. Repair torn or damaged geotextile by placing patch of same type of geotextile over damaged area minimum of 12 inches beyond edge of damaged area, and fasten as recommended by geotextile manufacturer.
2. Remove and replace geotextile rolls which cannot be repaired.

F. Fill and Cover:

1. Place fill to prevent tensile stress or wrinkles in geotextile.
2. Place fill from bottom of side-slopes upward.
3. Do not drop fill from height greater than 3 feet.

3.4 FIELD QUALITY CONTROL

A. Testing: According to ASTM D4354.

B. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

3.5 PROTECTION

A. Ballast: Adequate to prevent uplift of material by wind.

B. UV Exposure: Do not leave material uncovered for more than 14 days after installation.

C. Do not use staples or pins to hold geotextiles in place where located adjacent to other geosynthetic layers that could be damaged.

D. Do not operate equipment directly on top of geotextile.

END OF SECTION 31 05 19.13

SECTION 31 10 00 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing surface debris.
2. Removing designated paving, curbs, and concrete.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.

1.2 QUALITY ASSURANCE

A. Conform to applicable code for environmental requirements and disposal of debris.

B. Perform Work according to SCDHEC standards.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Except for materials indicated to be stockpiled or to remain Owner’s property, cleared materials shall become contractor’s property and shall be removed from the site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.

B. Identify waste area for placing removed materials.

3.2 PREPARATION

A. Call local utility line information service at 811 not less than three **(**3) working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Locate and clearly flag trees and vegetation to remain or to be relocated.

E. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.3 PROTECTION

A. Locate, identify, and protect utilities indicated to remain from damage.

B. Protect bench marks, survey control points, and existing structures from damage or displacement.

3.4 CLEARING

A. Clear areas required for access to Site and execution of Work to minimum depth of 6 inches.

B. Remove trees and shrubs within areas indicated on the plans. Remove stumps, main root ball, root system to depth of 18 inches, and surface rock.

C. Clear undergrowth and deadwood, without disturbing subsoil.

D. Use only hand methods for grubbing within drip line of remaining trees.

3.5 REMOVAL

A. Remove debris, rock, and extracted plant life from Site.

B. Remove paving, curbs, and concrete, as indicated.

C. Partially remove paving, curbs, and concrete as indicated. Neatly saw cut edges at right angle to surface.

D. Remove abandoned utilities. Indicated removal termination point for underground utilities on record documents.

E. Continuously clean-up and remove waste materials from Site. Do not allow materials to accumulate on Site.

F. Do not burn or bury materials on Site. Leave Site in clean condition.

END OF SECTION 31 10 00

SECTION 31 22 13 - ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating topsoil.
2. Excavating subsoil.
3. Cutting, grading, filling, rough contouring, and compacting, Site for Site structures, building pads, parking areas, and drives.

1.2 SUBMITTALS

A. Product data, if applicable.

1. Drainage fabric.
2. Geosynthetics.

B. Materials Source: Name of imported materials suppliers, if applicable.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

D. Test Reports: Submit test reports indicating suitability of all materials proposed to be supplied from off-site.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.4 QUALITY ASSURANCE

A. Perform Work according to ASTM C136, ASTM D2419, and ASTM D2434.

B. Perform Work according to SCDOT standards, within road right-of-way.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Satisfactory soils as specified in Section 310513.

B. Subsoil Fill: Satisfactory soils as specified in Section 310513.

C. Structural Fill: Satisfactory soils as specified in Section 310513.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify survey bench mark and intended elevations for Work are as indicated.

3.2 PREPARATION

A. Call local utility line information service at 811 not less than three (3) working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum.

C. Notify utility owner to remove and/or relocate utilities.

D. Protect utilities indicated to remain from damage.

E. Protect plant life, lawns, and other features remaining as portion of final landscaping.

F. Protect bench marks, survey control point, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 TOPSOIL EXCAVATION

A. Remove sod and grass before stripping topsoil.

B. Excavate topsoil from entire Site without mixing with foreign materials for use in finish grading.

C. Do not excavate wet topsoil.

D. Stockpile in area designated on Site to depth not exceeding ten (10) feet and protect from erosion.

E. Do not remove topsoil from Site.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, relandscaped, or regraded.

B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

C. When excavating through roots, perform Work by hand and cut roots with sharp axe.

D. Remove excess subsoil not intended for reuse, from Site.

E. Benching Slopes: Horizontally bench existing slopes greater than 4:1 to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. Fill areas to contours and elevations with unfrozen materials.

B. Place fill material in continuous layers and compact according to schedule at end of this Section.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

E. Make grade changes gradual. Blend slope into level areas.

F. Repair or replace items indicated to remain damaged by excavation or filling.

G. Install Work according to SCDOT standards, within road right-of-way.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 APPROVAL OF SUBGRADE

A. Notify Architect and Testing Agency when excavations have reached required subgrade.

B. If Architect or Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof roll subgrade with heavy pneumatic-tired equipment with a minimum loaded weight of 25 tons to identify soft pockets and areas in excess yielding. Do not proof roll wet or saturated subgrades.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities and retest, as directed by Architect.

3.8 FIELD QUALITY CONTROL

A. Perform laboratory material tests according to ASTM D698.

B. Perform in place compaction tests according to following:

1. Density Tests: ASTM D1556, ASTM D2167, and/or ASTM D2922, as applicable.
2. Moisture Tests: ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: once per lift of backfill.

3.9 SCHEDULES

A. Structural Fill (within limits of building pad):

1. To subgrade elevation at 6” thick lifts.
2. Compact uniformly to minimum 98 percent of maximum density.

B. Structural Fill (outside limits of building pad):

1. To subgrade elevation at 6” thick lifts.
2. Compact uniformly to minimum 95 percent of maximum density.

C. Subsoil Fill:

1. To subgrade elevation at 8” thick lifts.
2. Compact uniformly to minimum 95 percent of maximum density.

D. Topsoil Fill:

1. To finished grade at 6” thick.
2. Compact uniformly to minimum 90 percent of maximum density.

END OF SECTION 31 22 13

SECTION 31 23 16 - EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil densification.
2. Excavating for building foundations.
3. Excavating for paving, roads, and parking areas.
4. Excavating for slabs on grade.
5. Excavating for Site structures.
6. Excavating for landscaping.

1.2 SUBMITTALS

A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

B. Shop Drawings: Indicate soil densification grid for each size and configuration footing requiring soils densification.

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT standards, within road right-of-way.

B. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of South Carolina.

PART 2 - PRODUCTS

2.1 EXPLOSIVES: Remove identified and discovered rock during excavation with explosives per Section 312316.26.

PART 3 - EXECUTION

3.1 PREPARATION

A. Utility Service Locator:

1. Call local utility service-line information at 811 not less than three (3) working days before performing Work.

2. Request that underground utilities be located and marked within and immediately surrounding Site.
3. Identify required lines, levels, contours, and data.

B. Existing Utilities:

1. Notify utility owner to remove and/or relocate utilities.
2. Protect from damage utilities indicated to remain.

C. Protect plant life, lawns, and other features designated to remain as portion of final landscaping.

D. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 SOIL DENSIFICATION BY VIBRO-COMPACTION

A. Description:

1. Vibro-compact substrates below footing bearing surfaces for footings as indicated before excavating Site.
2. Densify existing subsoils with relative density rating of "compact to dense" to attain relative density rating of "very dense."
3. Densify subsoils to depth, as directed by a Geotechnical Engineer.

B. Equipment:

1. Depth Vibrator: Poker type with follower tubes with visible marking every 12 inches to enable insertion depth measurement.
2. Motion: radial in horizontal plane.
3. Eccentric Force, as directed by a Geotechnical Engineer.
4. Data Acquisition System: Record amps or pressure of vibrator motor over time and depth.

C. Procedure:

1. Perform densification in presence of Geotechnical Engineer.
2. Perform densification directly under each footing with vibrator inserted in grid pattern at maximum 6 feet o.c.
3. Arrange compaction grid for each footing for maximum number of insertion points, and with outermost insertion points within bearing area of footings.
4. Adjust compaction grid arrangement and spacing as directed by Geotechnical Engineer to achieve required densification.
5. Insert vibrator to maximum specified depth, densify soils for 30 seconds or other time as directed by Geotechnical Engineer, and withdraw vibrator every 12 inches while repeating densification at each increment.
6. If subsurface obstruction prevents vibrator insertion to specified depth, request instructions from Geotechnical Engineer to compensate for obstruction.

D. Tolerances:

1. Maximum Deviation from Center of Completed Compaction: 8 inches from indicated position.

2. Maximum Deviation from Vertical: 4 degrees during vibrator insertion.

3.3 EXCAVATION

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, and obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, contractor shall replace with satisfactory soil materials at no additional cost to the Owner.

B. Underpin adjacent structures which may be damaged by excavation Work.

C. Excavate subsoil to accommodate building foundations, slabs on grade, paving, Site structures, and construction operations.

D. Excavate to working elevation for piling Work.

E. Compact disturbed load-bearing soil in direct contact with foundations to original bearing capacity, as specified in Section 312323 – Fill, and Section 312316.13 - Trenching.

F. Slope banks with machine to angle of repose or less until shored.

G. Do not interfere with 45-degree bearing splay of foundations.

H. Grade top perimeter of excavation to prevent surface water from draining into excavation.

I. Trim excavation and remove loose matter.

J. Removal of Deleterious Materials:

1. Remove lumped subsoil, boulders, and rock up to 1 cu. yd. measured by volume.
2. Remove larger material as specified in Section 312323 - Fill.

K. Notify Engineer of unexpected subsurface conditions.

L. Correct over-excavated areas with structural fill Type as specified in Section 312323 - Fill.

M. Remove excavated material from Site not intended for reuse.

N. Repair or replace items indicated to remain that have been damaged by excavation.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. 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. Excavation for Underground 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 for bearing surface.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide a working 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 on each side of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

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 may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.8 FIELD QUALITY CONTROL

A. Request visual inspection of bearing surfaces by Geotechnical Engineer and/or Engineer before installing subsequent Work.

3.9 PROTECTION

A. Prevent displacement or loose soil from falling into excavation and maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that may be created by earth operations.

END OF SECTION 31 23 16

SECTION 31 23 16.13 - TRENCHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating trenches for utilities from 5-ft outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

1.2 SUBMITTALS

A. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

B. Product Data: Geotextile fabric indicating fabric and construction.

C. Materials Source: Name of imported fill materials suppliers, if applicable.

D. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT standards within road right-of-way.

B. Prepare excavation protection plan under direct supervision of professional engineer experienced in design of this Work and licensed in State of South Carolina.

1.4 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.5 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

A. Subsoil Fill: Satisfactory soils as specified in Section 310513.

B. Structural Fill: Satisfactory soils as specified in Section 310513.

C. Granular Fill: Aggregates as specified in Section 310516.

D. Concrete:

1. Structural concrete as specified in Section 033000 with compressive strength of 4,000 psi.

2.2 ACCESSORIES

A. Geotextile Fabric: Non-biodegradable, non-woven.

PART 3 - EXECUTION

3.1 LINES AND GRADES

A. Lay pipes to lines and grades indicated.

1. Engineer may make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

B. Use laser-beam instrument with qualified operator to establish lines and grades.

3.2 PREPARATION

A. Call local utility line information service at 811 not less than 3 working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Identify required lines, levels, contours, and datum locations.

C. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

F. Establish temporary traffic control when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.3 TRENCHING

A. Excavate subsoil required for utilities to utility service.

B. Remove lumped subsoil, boulders, and rock up of 1/6 cu yd, measured by volume. Remove larger material as specified in Section 312316.

C. Perform excavation within 24 inches of existing utility service according to utility owners' requirements.

D. Do not advance open trench more than 200 feet ahead of installed pipe.

E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

F. Excavate bottom of trenches maximum 24 inches wider than outside diameter of pipe.

G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

H. Do not interfere with 45-degree bearing splay of foundations.

I. When Project conditions permit, slope side walls of excavation starting 24 inches above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.

J. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Geotechnical Engineer until suitable material is encountered.

K. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent backfill material.

L. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

M. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Geotechnical Engineer.

N. Remove excess subsoil not intended for reuse, from Site.

3.4 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Design sheeting and shoring to be removed at completion of excavation Work.

D. Repair damage caused by failure of sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Place geotextile fabric as directed by Geotechnical Engineer.

D. Place fill material in continuous layers and compact according to schedule at end of this Section.

E. Employ placement method that does not disturb or damage foundation perimeter drainage, utilities in trench, and other site features.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Do not leave any trench open at end of working day.

3.6 TOLERANCES

A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 FIELD QUALITY CONTROL

A. Perform laboratory material tests according to ASTM D698.

B. Perform in place compaction tests according to following:

1. Density Tests: ASTM D1556, ASTM D2167, and/or ASTM D2922, as applicable.
2. Moisture Tests: ASTM D3017.

C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

D. Frequency of Tests: Once per lift of backfill.

3.8 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.9 SCHEDULE

A. Storm and Sanitary Piping:

1. Cover pipe and bedding with structural fill: To subgrade elevation. 6” thick.
2. Compact uniformly to minimum 95 percent of maximum density.

B. Duct Bank:

1. Cover duct and bedding with structural fill: To subgrade elevation. 6” thick.
2. Compact uniformly to minimum 95 percent of maximum density.

END OF SECTION 31 23 16.13

SECTION 31 23 16.26 - ROCK REMOVAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removing identified and discovered rock during excavation.
2. Expansive tools and Explosives to assist rock removal.

1.2 DEFINITIONS

A. Site Rock: Solid mineral material with volume in excess of 1 cu yd or solid material that cannot be removed with 3/4 cu yd capacity excavator without drilling or blasting. Refer to section 310513 for additional information.

B. Trench Rock: Solid mineral material with volume in excess of 3/4 cu yd or solid material that cannot be removed with 3/4 cu yd capacity excavator without drilling or blasting. Refer to section 310513 for additional information.

1.3 SUBMITTALS

A. Shop Drawings: Indicate proposed method of blasting, delay pattern, explosive types, type of blasting mat or cover, and intended rock removal method.

B. Survey Report: Conditions of buildings near locations of rock removal.

1.4 QUALITY ASSURANCE

A. Seismic Survey Firm: Licensed company specializing in seismic surveys with five years' experience.

B. Explosives Firm: Company specializing in explosives for disintegration of rock, with five years' experience.

1.5 PROJECT CONDITIONS

A. Conduct survey and document conditions of buildings near locations of rock removal, prior to blasting, and photograph existing conditions identifying existing irregularities.

B. Advise owners of adjacent buildings or structures in writing, prior to executing seismographic survey. Explain planned blasting and seismic operations.

C. Obtain seismic survey prior to rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties or other Work.

1.6 SCHEDULING

A. Schedule Work to avoid disruption to occupied buildings nearby.

B. Conduct blasting operations between hours of 9:00 AM and 4:00 PM only.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Explosives: Type recommended by explosive firm following seismic survey and required by authorities having jurisdiction.

B. Delay Device: Type recommended by explosives firm.

C. Blast Mat Materials: Type recommended by explosives firm.

D. Mechanical Disintegration Compound: Type recommended by explosives firm.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify Site conditions and note subsurface irregularities affecting Work of this Section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical method.

1. Drill holes and use expansive tools, wedges and/or mechanical disintegration compound to fracture rock.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings and foundations.

D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

E. Remove excavated materials from Site.

F. Correct unauthorized rock removal according to backfilling and compacting requirements of Section 312323.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. When rock is uncovered requiring explosives method for rock disintegration, notify Engineer.

B. Provide seismographic monitoring during progress of blasting operations.

C. Drill blasting holes within 12 feet of finished slope.

D. Disintegrate rock and remove from excavation.

E. Remove rock at excavation bottom to form level bearing.

F. Remove shaled layers to provide sound and unshattered base for footings and foundations.

G. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

H. Remove excavated material from Site.

I. Correct unauthorized rock removal according to backfilling and compacting requirements of Section 312323.

3.5 FIELD QUALITY CONTROL

A. Request visual inspection of foundation bearing surfaces by Geotechnical Engineer and/or Engineer before installing subsequent Work.

END OF SECTION 31 23 16.26

SECTION 31 23 19 - DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Surface water control system.
2. System operation and maintenance.
3. Water disposal.

1.2 DEFINITIONS

A. Dewatering:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and shafts.
2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and shafts.
3. Disposing of removed water.

B. Piezometer: A tube inserted into a vessel or pipe to indicate the height (pressure) that a liquid can rise in the tube.

C. Pitometer: A measuring device that transforms a differential pressure into an electrical output current proportional to the flow rate.

D. Surface Water Control: The removal of surface water within open excavations.

1.3 SUBMITTALS

A. Product Data:

1. Submit sizes, capacities, priming method, and motor characteristics for dewatering pumps.
2. Submit pumping equipment for control of surface water within excavation.

B. Shop Drawings:

1. Indicate dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, filter sand gradations, surface water control devices, valves, and water disposal method and location.
2. Indicate primary and standby power system location and capacity.
3. Indicate layout and depth of monitoring wells, piezometers, and flow measuring devices for system performance measurement.
4. Include detailed description of dewatering and monitoring system installation procedures and maintenance of equipment.
5. Include description of emergency procedures to follow when problems arise.

C. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings.
2. Indicate design values, analyses, assumptions, and calculations to support design.
3. Include description and profile of geology, soil, and ground water conditions.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and depths of capped wells and piping abandoned in place.

1.5 QUALITY ASSURANCE

A. Comply with authorities having jurisdiction for following:

1. Drilling and abandoning of wells used for dewatering systems.
2. Water discharge and disposal from pumping operations.

B. Obtain permit from SCDHEC under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from Site.

C. Perform Work according to SCDOT standards within road right-of-way.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish dewatering and surface water control systems to permit Work to be completed on dry and stable subgrade.

B. Provide monitoring wells and monitoring equipment to obtain meaningful observations of conditions affecting excavation, adjacent structures, and adjacent water wells.

C. Furnish standby equipment stored at Project Site and ready for immediate use upon failure of dewatering equipment.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Design:

1. Lower water table within areas of excavation to minimum 5 feet below bottom of excavation to permit Work to be completed on dry and stable subgrade.
2. Relieve hydrostatic pressures in confined water bearing strata below excavation to eliminate risk of uplift or other instability of excavation.
3. Prevent damage to adjacent properties, buildings, structures, utilities, and other facilities from construction operations.
4. Prevent loss of fines, quick condition, or softening of foundation subgrade.

5. Maintain stability of sides and bottoms of excavations and trenches.
6. Surface Water Control System: Collect and remove surface water and seepage entering excavation.

2.3 DEWATERING EQUIPMENT

A. Select dewatering equipment to meet specified performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conduct additional borings and investigations to supplement subsurface investigations identified in Document 003100 - Available Project Information, as required to complete dewatering system design.

B. Utility Service Locator:

1. Call local utility service-line information at 811 not less than 3 working days before performing Work.
2. Request that underground utilities be located and marked within and immediately surrounding Site.

3.2 PREPARATION

A. Protect existing adjacent buildings, structures, and improvements from damage that may be caused by dewatering operations.

3.3 SURFACE WATER CONTROL SYSTEM

A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.

B. Divert surface water and seepage water within excavation areas into sumps and pump water into drainage channels, storm drains and/or settling basins in accordance with requirements of authorities having jurisdiction.

C. Control and remove unanticipated water seepage into excavation.

3.4 SYSTEM OPERATION AND MAINTENANCE

A. Operate dewatering system continuously until backfilling is complete.

B. Provide 24-hour supervision of dewatering system by personnel skilled in operation, maintenance, and replacement of system components.

C. If dewatering system cannot control water within excavation, notify Engineer and stop excavation work.

D. Modify dewatering and surface water control systems if operation causes or threatens to cause damage to new construction, existing Site improvements, adjacent property, or adjacent water wells.

E. Do not discontinue dewatering operations without approval of Engineer.

3.5 WATER DISPOSAL

A. Discharge water into storm sewer system, drainage channels and or settling basins.

3.6 SYSTEM REMOVAL

A. Remove dewatering and surface water control systems after dewatering operations are discontinued.

B. Remove piezometers and monitoring wells.

C. Fill abandoned wells with sand.

D. Abandoned Wells:

1. Cut off and cap abandoned wells minimum 36 inches below completed subgrade elevation.
2. Fill abandoned piping with grout.

E. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

3.7 FIELD QUALITY CONTROL

A. Testing:

1. After dewatering system is installed, perform pumping test to determine at what point selected pumping rate lowers water level in well below pump intake.
2. Adjust pump speed, discharge volume, or both to ensure proper operation of each pump.

B. Monitoring and Recording:

1. Daily:

    a. Note average discharge flow rate for each deep well, eductor header, well point, and ground water elevation.
    b. Continue monitoring daily until steady state conditions occur, then monitor and record conditions twice each week.

2. Sand Content:

    a. Monitor ground water discharge for sand content.
    b. Sample and test water from each well bi-weekly for sand content.
    c. Maximum Permitted Sand Content: 5 ppm.

3. Contaminates:

    a. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.
    b. Sample and test water bi-weekly for contaminates.

4. Existing Adjacent Buildings, Structures, and Improvements:

    a. Survey bi-weekly during dewatering to detect movement in comparison to original elevations.
    b. Notify Engineer immediately of measured movement.

END OF SECTION 31 23 19

SECTION 31 23 23 - FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling Site structures to subgrade elevations.
3. Fill under slabs on grade.
4. Fill under paving.
5. Fill for over-excavation.

1.2 SUBMITTALS

A. Product Data: Geotextile fabric indicating fabric and construction.

B. Materials Source: Submit name of imported materials suppliers, if applicable.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT standards within road right-of-way.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subsoil Fill: Satisfactory soils as specified in Section 310513.

B. Structural Fill: Satisfactory soils as specified in Section 310513.

C. Granular Fill: Aggregates as specified in Section 310516.

D. Concrete:

1. Structural as specified in Section 033000 - Cast-in-Place Concrete with compressive strength of 4,000 psi.

2.2 ACCESSORIES

A. Geotextile Fabric: As specified in Section 310519.13 - Geotextiles for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subdrainage, dampproofing, and waterproofing installations have been inspected.

B. Verify that underground tanks are anchored to their own foundations to avoid flotation after backfilling.

C. Verify structural integrity of unsupported walls to support loads imposed by fill.

3.2 PREPARATION

A. Compact subgrade to specified density requirements for subsequent backfill materials.

B. Soft Subgrade:

1. Cut out soft areas of subgrade not capable of compaction in place.
2. Backfill with structural fill and compact to density equal to or greater than specified requirements for subsequent fill material.

C. Scarify subgrade surface to depth of 6 inches.

3.3 BACKFILLING

A. Backfill areas to contours and elevations.

B. Systematically backfill to allow maximum time for natural settlement.

C. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces, and do not backfill with frozen materials.

D. Maximum Compacted Depths:

1. Place material in continuous layers to following depths:

a. Subsoil Fill: 8 inches.
b. Structural Fill: 6 inches.
c. Granular Fill: 6 inches.

E. Use placement method that does not disturb or damage foundation perimeter drainage, utilities in trench, or other site features.

F. Maintain optimum moisture content of fill materials to attain required compaction density.

G. Structures:

1. Backfill against supported foundation walls.
2. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

3. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet.

H. Make gradual grade changes, and blend slope into level areas.

I. Remove surplus backfill materials from Site.

3.4 TOLERANCES

A. Top Surface of Backfilling within Building Areas: Plus or minus 1 inch from required elevations.

B. Top Surface of Backfilling under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

A. Perform laboratory material tests according to ASTM D698.

B. In-Place Compaction Testing:

1. Density Tests: ASTM D1556/D1556M, ASTM D2167, and/or ASTM D6938, as applicable.
2. Moisture Tests: ASTM D6031/6031M.

C. If tests indicate that Work does not meet specified requirements, remove Work, replace, compact, and retest.

D. Testing Frequency: Once per lift of backfill.

E. Proof-roll compacted fill surfaces under slabs on grade and all paving areas. Refer to Section 3.7 of Rough Grading Specification (312213) for additional information.

3.6 PROTECTION

A. Reshape and recompact fills subjected to vehicular traffic during construction.

END OF SECTION 31 23 23

SECTION 31 25 00 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diversion Channels.
2. Rock Energy Dissipator.
3. Paved Energy Dissipator.
4. Rock Basin.
5. Rock Barriers.
6. Sediment Ponds.
7. Sediment Traps.

1.2 SUBMITTALS

A. Product Data: Joint filler, Joint sealer, Admixtures, Curing compounds, Geotextile.

B. Proposed Mix Design: Furnish design of each class of concrete for review prior to commencement of Work.

C. Test Reports: Indicate certified tests results for precast concrete at manufacturing facility, cast-in-place concrete in field, and granular backfill.

D. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Perform Work according to requirements of Section 310513, Section 310516, Section 312323, Section 311000, Section 312316, Section 313716.13, Section 334200, Section 329119, and Section 329219.

B. Perform Work according to SCDHEC standards.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not place grout when air temperature is below freezing.

B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 ROCK AND GEOTEXTILE MATERIALS

A. Rock:

1. As specified in Section 310516.
2. As specified in Section 313716.13.

B. Geotextile Fabric:

1. As specified in Section 310519.13.

2.2 CONCRETE MATERIALS AND REINFORCEMENT

A. Cement:

1. Type 1, grey, as specified in Section 033000.

B. Fine and Coarse Aggregates:

1. As specified in Section 033000 and Section 310516.

C. Water: Clean and not detrimental to concrete.

D. Admixtures:

1. Air Entrainment: Comply with ASTM C260.
2. Chemical:

a. Type A, as specified in Section 033000.

3. Fly Ash or Calcined Pozzolan:

a. As specified in Section 033000.

4. Plasticizing:

a. As specified in Section 033000.

E. Aggregate, Sand, Water, Admixtures: Precast: Determined by precast fabricator, as appropriate to design requirements and PCI MNL-116S.

F. Reinforcement Steel:

1. Deformed bars, galvanized, as specified in Section 321313.

G. Welded Steel Wire Fabric:

1. Deformed Type, flat sheets, unfinished, as specified in Section 321313.

2.3 BLOCK, STONE, AGGREGATE, AND SOIL MATERIALS

A. Precast Solid Concrete Block:

1. Furnish according to SCDOT standards, and in accordance with Plans.

B. Stone:

1. Granite, Limestone.
2. Furnish according to SCDOT standards, and in accordance with Plans.

C. Coarse Aggregate:

1. As specified in Section 310516.

D. Soil Backfill: As specified in Section 310513. Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter.

2.4 PLANTING MATERIALS

A. Seeding and Soil Supplements:

1. As specified in Section 329219.
2. Furnish according to SCDHEC standards.

B. Mulch:

1. As specified in Section 329219.
2. Furnish according to SCDHEC standards.

2.5 PIPE MATERIALS

A. Pipe:

1. Corrugated PE, as specified in Section 334200.
2. Concrete, as specified in Section 334200.
3. Plastic, as specified in Section 334200.

2.6 ACCESSORIES

A. Joint Sealers:

1. As specified in Section 033000.

B. Joint Filler:

1. As specified in Section 033000.

C. Grout:

1. As specified in Section 033000.

D. Steel Plate Anti-Vortex Device:

1. Furnish according to SCDHEC standards, and in accordance with Drawings.

E. Welding Material:

1. Furnish according to SCDHEC standards, and in accordance with Drawings.

F. Anti-Seep Collar:

1. Furnish according to SCDHEC standards, and in accordance with Drawings.

G. Trash Rack:

1. Furnish according to SCDHEC standards, and in accordance with Drawings.

2.7 MIXES

A. Concrete:

1. 3000 psi, as specified in Section 033000.
2. Furnish according to SCDHEC standards, and in accordance with Plans.

2.8 SOURCE QUALITY CONTROL (AND TESTS)

A. Perform tests on cement, aggregates, and mixes to ensure conformance with specified requirements.

B. Test samples according to ACI 301.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade, granular base, stabilized soil is acceptable and ready to support devices and imposed loads.

B. Verify gradients and elevations of base or foundation for other Work are correct.

3.2 DIVERSION CHANNELS

A. Windrow excavated material on low side of channel.

B. Compact to 95 percent maximum density.

C. On entire channel area, apply soil supplements and sow seed as specified in Section 329219.

D. Mulch seeded areas with hay as specified in Section 329219.

E. Install Work according to SCDHEC standards.

3.3 ROCK ENERGY DISSIPATOR

A. Excavate to indicated depth of rock lining or nominal placement thickness as follows. Remove loose, unsuitable material below bottom of rock lining, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

1. Nominal Placement Thickness per NCSA Class:

a. R8: 48 Inches
b. R7: 36 Inches
c. R6: 30 Inches
d. R5: 24 Inches
e. R4: 18 Inches
f. R3: 12 Inches

B. Lay and overlay geotextile fabric over substrate. Lay fabric parallel to flow from upstream to downstream. Overlap edges upstream over downstream and upslope over downslope Provide a minimum overlap of 3 feet. Offset adjacent roll ends a minimum of 5 feet when lapped. Cover fabric as soon as possible and in no case leave fabric exposed more than four weeks.

C. Carefully place rock on geotextile fabric to produce an even distribution of pieces, with minimum of voids and without tearing geotextile.

D. Unless indicated otherwise, place full course thickness in one operation to prevent segregation and to avoid displacement of underlying material. Arrange individual rocks for uniform distribution.

1. Saturate rock with water. Fill voids between pieces with grout, for at least top 6 inches. Sweep surface with stiff broom to remove excess grout.
2. Moist cure grouted rock for at least three days after grouting, using water saturated burlap according to Section 033000.

E. Install Work according to SCDHEC standards.

3.4 PAVED ENERGY DISSIPATOR

A. Excavate to required paving depth. Remove loose, unsuitable material below bottom of paving, then replace with suitable material. Thoroughly compact and finish entire foundation area to firm, even surface.

B. Place forms and reinforcement according to Section 321313. Hold reinforcement firmly in position during placing of concrete.

C. Mix, place, finish, and cure concrete, as specified in Section 321313.

D. Embed stones or blocks 3 inches in plastic concrete at indicated separation on slopes and channel bottom.

E. Pave in uniform 10 foot lengths or sections.

F. Pave in shorter sections as necessary for closures or curves.

G. Place premolded expansion joint filler, 1/2 inch thick, cut to conform to paving cross sections, at ends of curved sections at intervals of not more than 100 feet, at end of day's work, and where paving is adjacent to rigid structure. Use joint filler with depth of 1/2 inch less than paving depth and press firmly against adjacent concrete.

H. Form intermediate joints between sections, with two thicknesses of bituminous paper cut neatly to paving cross section.

I. Seal joint top with joint sealer.

J. Install Work according to SCDOT standards.

3.5 ROCK BASIN

A. Construct generally according to rock energy dissipator requirements to indicated shape and depth. Rock courses may be placed in several operations, but minimum depth of initial course must be 3 feet or greater.

3.6 ROCK BARRIER

A. Determine length required for ditch or depression slope and excavate, compact and foundation area to firm, even surface.

B. Produce an even distribution of rock pieces, with minimum voids to indicated shape, height and slope.

C. Construct coarse aggregate filter blanket against upstream face of rock barrier to indicated thickness.

D. Install Work according to SCDHEC standards.

3.7 SEDIMENTATION POND

A. Clear and grub storage area and embankment foundation area site as specified in Section 311000.

B. Excavate key trench for full length of dam. Excavate emergency spillway in natural ground.

C. Install pipe spillway, with anti-seep collar attached, at location indicated.

D. Place forms and reinforcing for concrete footing at bottom of riser pipe with trash rack and anti-vortex device. Construction of embankment and trench prior to placing pipe is not required.

E. Mix, place, finish, and cure concrete, as specified in Section 033000.

F. Do not use coarse aggregate as backfill material around pipe. Backfill pipe with suitable embankment material to prevent dam leakage along pipe.

G. Construct rock basin at outlet end of pipe, as specified in this Section. Place embankment material, as specified in Section 312323. When required, obtain borrow excavation for formation of embankment, as specified in Section 312323.

H. On entire sedimentation pond area, apply soil supplements and sow seed as specified in Section 329219.

I. Mulch seeded areas with hay as specified in Section 329219.

J. Install Work according to SCDHEC standards.

3.8 SEDIMENT TRAPS

A. Clear Site, as specified in Section 311000.

B. Construct trap by excavating and forming embankments as specified in Section 312316, and Section 312323.

C. Place coarse aggregate or rock at outlet as indicated on Drawings.

D. Place geotextile fabric, as specified for rock energy dissipator.

E. When required, obtain borrow excavation for formation of embankment, as specified in Section 312316.

F. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 329219.

G. Mulch seeded areas with hay as specified in Section 329219.

H. Install Work according to SCDHEC standards.

3.9 SITE STABILIZATION

A. Incorporate indicated erosion control devices into Project at earliest practicable time.

B. Construct, stabilize and activate erosion controls before Site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 10 feet. Slope stockpile sides at 4:1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 14 days.

1. During non-germinating periods, apply mulch at recommended rates.
2. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year according to Section 329219 permanent seeding specifications.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.10 FIELD QUALITY CONTROL

A. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

B. Field test concrete according to Section 033000.

C. Compaction Testing: As specified in Section 312323.

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

E. Frequency of Compaction Testing: One for each lift.

3.11 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or Site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately one-half channel depth.

3.12 PROTECTION

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

B. Do not permit construction traffic over paving for seven days minimum after finishing.

C. Protect paving from elements, flowing water, or other disturbance until curing is completed.

END OF SECTION 31 25 00

SECTION 31 66 12 - GROUTED HELICAL STEEL PILES

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 Grouted Helical Steel Piles and associated hardware.

B. Related Sections

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.

2. Division 03 Section "Cast-in-place Concrete" for foundation concrete and reinforcing steel.

1.3 DEFINITIONS

A. Grouted Helical Steel Piles: Steel helical piles drilled using a series of helical disks on a continuous hollow core steel tube shaft with a permanent and full depth grouted collar. Piles are installed using rotary equipment that extends the helical shaft to the designed embedment depth while also creating an annular space for the grout collar. For the purposes of this project augercast micropiles are not consider injection grouted micropiles.

1.4 UNIT PRICES

A. The Contract Sum:

1. Base the Contract Sum on number, size and length of piles indicated from tip to head, plus not less than 12 inches of overlength. The length of pile shall be per delegated design and shall be included in the cost of the work. No adjustments in cost shall be made relative to length.
2. If an accepted substitution request pile is implemented on the project the contractor will be solely responsible for the production piles complying with the requirements of the project. Contract cost adjustments (i.e. unit cost adjustments) will not be permitted for necessary changes in any substitution request pile parameters (i.e. length, diameter, reinforcement) in order to provide a test pile and ultimately production piles that comply with the contract document requirements.

B. Work of this Section is affected as follows:

1. The final length of pile will be confirmed or adjusted based on test pile results.

2. Unit prices include labor, materials, tools, equipment, and incidentals for installing piles
3. No payment will be made for rejected piles, including piles installed out of tolerance, defective piles, or piles that fail inspection and cannot be substantiated for use as production piles.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide steel pile assemblies capable of withstanding the design loads indicated within the limits and under the conditions indicated.

1. IBC 2021

2. Data used in design shall be obtained through a test program complying with ICC-AC 358

3. Capacities shall be calculated in accordance with the methodology indicated in ICC-AC 358.

B. Geotechnical Capacity: The overall length and installation torque of the pile shall be designed such that soil capacity is developed by end bearing of helix plate(s) in appropriate strata(s).

1. End bearing shall not be developed in liquefiable layers.

2. Piles shall be capable of resisting the required loading in addition to down drag/negative skin friction forces including those resulting from earthquake induced liquefaction.

3. The allowable geotechnical capacity shall be based on a safety factor of 2.5.

C. Lateral Load and Bending: Where lateral loads are indicated the bending moments from those loads shall be determined using a lateral load analysis program that is capable of modeling the linear elastic properties of the soil column.

1. The modeled soil column shall account for the effects of liquefaction.

2. The allowable load shall be one half of the load that results in a pile head deflection of 1".

3. A pinned head condition shall be assumed unless note otherwise.

D. Structural Capacity:

1. The structural capacity of the steel pile shall be based on the limiting strength element.

a. Structural capacity shall be based on reduced material dimension based on

the sacrificial thickness anticipated based on the corrosion loss.

b. The design life for purpose of corrosion loss shall be 120 years.

c. The project soil conditions are aggressive.

2. Where lateral load requirements existing the structural capacity shall account for the interaction of bending and compression, and bending and tension.

3. The pile shall be checked for buckling using a lateral load analysis program that is capable of modeling the linear elastic properties of the soil column including the effects of liquefaction

4. The flexural length of the pile is 15 feet from the pile head. Drill casing shall be provided for a minimum distance equal to the flexural length.
5. Load transfer devices and connection hardware shall distributed loads to the foundation as indicated in the drawings and such that concrete stresses do not exceed the limits of ACI 318.

1.6 SUBMITTALS

A. Contractor's Statement of Responsibility Per Division 01 Section "Collective Inspections and Structural Testing"

B. Product Data:

1. Pile Helix Section

2. Pile Extension Section

3. Other Special Pile Sections

4. Load Transfer Devices

5. Connection Hardware

6. Galvanizing Repair Paint

C. Shop Drawings:

1. The shop drawing package shall be signed and sealed by the professional engineer responsible for the pile design.

2. Show fabrication and installation details for piles, including details of load transfer devices, connection hardware, splices, and special hardware required for installation.

3. Clearly identify the required corrosion protection.

4. Includes a pile schedule for each type or capacity of pile including the following:

a. Product designations for helix and extension sections and all ancillary products to be supplied for that type or capacity of pile

b. The allowable pile load as limited by mechanical or geotechnical allowable strength

c. Required pile flexural, compression and tension capacities.

d. The calculated allowable mechanical strength for the pile assembly including connection hardware and load transfer device. The strength shall account for the designed tolerance.

e. The allowable theoretical geotechnical capacity

f. Minimum effective torsional resistance

g. Maximum allowable installation torque

h. Minimum embedment length

i. Inclination angle tolerance requirement

j. Location tolerance requirement

5. If pile type, configuration, embedment or other factors vary provide a plan layout indicating each pile and designating it in a manner to tie each pile to the pile schedule.

6. If pile layout is part of the performance based submittal provide a plan layout indicating each pile and designating it in a manner to tie each pile to the pile schedule. Locate and identify all known easements, right of ways or obstructions to demonstrate how the piles will be installed to miss these items.

7. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

8. Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Delegated-Design Submittal:

1. Provide structural design data signed and sealed by the qualified professional engineer responsible for their preparation. Calculations shall include the following:

a. Calculated allowable theoretical geotechnical capacity for each type, embedment and/or torsional resistance criteria.

b. Calculated allowable structural capacity for each type and configuration of

pile.

c. Calculated allowable lateral load for each type of pile.

d. Maximum allowable installation torque for each pile type

e. Minimum effective torsional resistance criteria

f. Maximum location and inclination angle tolerance accounted for in the design of the pile, load transfer device and connection hardware.

E. Qualification Data:

1. Engineer:

a. Evidence of registration to practice structural engineering in the jurisdiction where Project is located.

b. A written recommendation from the pile manufacturer, pile distributor, or manufacturer's representative for the unit being specified indicating competence in the design using the specific unit.

c. A list of at least three projects which were designed by the engineer within the previous three years using piles of types similar to those required for this project, using equipment similar to that required for this project, and under similar conditions required for this project.

2. Installer:

a. Certificate from unit manufacturer that the installer has been trained and is certified for the installation of the unit.

b. A list of at least three projects completed within the previous three years wherein the installer installed piles of types similar to those required for this project, using equipment similar to that required for this project, and under similar conditions required for this project

c. A letter from the pile manufacturer, pile distributor or the manufacturer's representative expressing ability and intent to provide on-site supervision of the pile installation.

3. Pile Manufacturer:

a. Confirmation of at least three years of production of helical piles of type similar to those required on this project.

b. A list of at least three engineered construction projects completed in the last three years where the manufacturer's helical piles similar to type required for this project were used successfully using equipment similar to that required for this project, and under similar conditions required for this

project.

c. Building Code Approval: Submit one of the following.

1) ICC report for the specific pile type being used on this project

2) Written acceptance for the specific pile type being used on this project by the building official having jurisdiction over this project.

F. Design Mixtures: For each final grout mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Mix design submittals shall include field test results and/or trial batch data that meet or exceed the required average compressive strength.
2. Trial batches shall consist of identical cementitious materials, fine and course aggregates, and admixtures to be used for mix design.

G. Welding certificates

1. Submit welding certificates for all individuals expected to be performing field welding

H. Welding Procedure Specifications (WPS's) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each field welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).

I. Pile-Installation Equipment Data:

1. Indicate type, make, and rating of equipment to be used for pile installation

2. Indicate equipment and method to be used for measuring torsional resistance during installation

3. Copies of certified calibration reports for torque and load measuring equipment to be used on the project. The calibrations shall be dated within one year of the proposed starting date for pile installation.

J. Research/Evaluation Reports:

1. Submit results of generic load test program and all supporting documentation to indicate compliance with ICC-AC 358.

2. Submit confirmation on company letter head that project specific design values are achieved in accordance with ICC-AC 358.

K. As built pile survey

1.7 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications:

1. 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.

2. Shall be able to obtain a recommendation from the pile manufacturer, pile distributor, or manufacturer's representative for the unit being specified indicating competence in the design using the specific unit.

3. The engineer shall have completed the design for at least three projects within the previous three years using piles of types similar to those required for this project, using similar equipment for this project, and under similar conditions required for this project.

C. Installer Qualifications:

1. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

2. The installer shall have completed at least three projects within the previous three years wherein the installer installed piles of types similar to those required for this project, using similar equipment required for this project, and under similar conditions required for this project.

3. Ability to obtain field support from the pile manufacturer, the pile distributor or the manufacturer's representative.

D. Manufacturer Qualifications:

1. At least three years of production of helical piles of type similar to those required on this project.

2. The manufacturer's helical piles similar to type required for this project shall have been used successfully in at least three engineered construction projects in the last three years using equipment similar to that required for this project, and under similar conditions required for this project.

3. The manufacturer's piles shall have an ICC report or shall have written acceptance by the building official having jurisdiction over this project.

E. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

F. Welding Qualifications: Qualify procedures and personnel according to

AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent buckling or physical damage.

1.9 PROJECT CONDITIONS

A. Protect structures, underground utilities, and other construction from damage caused by pile installation.

B. Site Information: A geotechnical report has not been prepared for this Project. It shall be required as part of the delegated design work for the pile design. The subcontractor shall obtain the services of a registered geotechnical engineer to perform tests and studies as required for the pile design.

PART 2 - PRODUCTS

2.1 CORROSION RESISTANCE

A. All pile materials including load transfer devices and connection hardware shall be hot dip galvanized per ASTM A123 or ASTM A153.

2.2 STEEL HELICAL PILES

A. Central Steel Shafts: Hot rolled steel bar, Structural Steel Tube or Structural Steel Pipe.

B. Helix Bearing Plates: Hot rolled carbon steel sheet, strip or plate formed on matching metal dies to true helix shape and uniform pitch.

C. Couplings: Integrally formed as hot upset forged sockets, cast sleeve for connecting shafts together, or tubing or steel bar for connection shafts together.

2.3 GROUT MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type I/II or Type III, Supplement with the following:

B. Fine Aggregates: ASTM C 33.

1. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
2. Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable, and complying with ASTM C94

D. Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures.

1. Air-Entraining Admixture: ASTM C 260.
2. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
3. Retarding Admixture: ASTM C 494/C 494M, Type B.
4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
6. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 GROUT MIXES

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, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Grout shall be a neat cement grout or sand-cement grout.

C. Approved admixtures may be used in grout if they were included in the mix design.

D. Drilling and Flushing grout shall have a minimum water-cement ratio of 0.70.

E. Final Grout shall have a minimum water-cement ration of 0.45.

F. Compressive Strength: As required by delegated design, but not less than 4000 psi.

G. The grout mix shall be capable of maintaining the solids in suspension, shall be pumped without difficulty, and shall be capable of penetrating and filling voids in the adjacent soils.

H. Limit water-soluble chloride ion content in hardened concrete to 0.15 percent by weight of cement.

2.5 PILE ACCESORIES

A. Load transfer devices and connection hardware shall be constructed of hot dip galvanized welded assemblies.

B. Bolts, rods, nuts and washers shall be hot dip galvanized of structural grade.

2.6 PAINT

A. Galvanizing Repair Paint: ASTM A 780.

2.7 FABRICATION

A. Fabricate and assemble piles in shop to greatest extent possible.

B. Fit and weld helixes, load transfer devices and connection hardware according to manufacturer's written instructions and AWS D1.1/D1.1M for procedures, appearance and quality of welds, and methods used in correcting welding work.

C. Mark pile sections, load transfer devices and connection hardware to allow correlation with the pile design shop drawings and documentation.

2.8 INSTALLATION EQUIPMENT

A. Equipment shall be rotary type, hydraulic power driven torque motor with clockwise and counter clockwise rotational capability and capable of adjustments to revolutions per minute during installation

B. Percussion drilling equipment shall not be permitted

C. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central shaft to be installed.

D. Equipment shall be capable of applying adequate downward pressure and torque simultaneously to suit project conditions and load requirements.

E. The equipment shall be capable of continuous position adjustment to maintain proper helical pile location and alignment.

F. Torque indicator:

1. Shall be capable of providing continuous measurement of applied torque throughout installation.

2. Shall be capable of torque measurements to at least 500 ft-lb increments

3. Shall be calibrated prior to pre-production test pile installation or start of production work if test pile program is not used.

4. Shall be re-calibrated if in the opinion of the owner, contractor or inspector reasonable doubt exists as to the accuracy of the torque measurements.

G. All installation equipment shall be in accordance with the installation recommendations of the pile manufacturer.

H. All specialty equipment, adaptors or other proprietary devices shall be used as required by the pile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Conditions: Do not start pile-driving operations until earthwork fills have been completed or excavations have reached an elevation of 6 to 12 inches above bottom of footing or pile cap.

3.2 INSTALLING PILES

A. General: Installation technique shall be consistent with the geotechnical, logistical, environmental and load carrying conditions of the project.

1. Where test piles where employed production piles shall be installed with the same techniques of that used for test piles.

B. Battered Piles: Battered piles shall be positioned perpendicular to the ground to assist in initial advancement into the soil before establishing the required batter angle.

C. Helical pile sections shall be engaged and advanced into the soil in a smooth, continuous manner at a rotational rate of 5 to 25 rotations per minute.

D. A section with a displacement plate or cone shall be installed after the initial helical sections to create the displaced core for the grout shell.

E. Grout shall be continuously pumped into the core to form a continuous uniform grout shaft of minimum 10” diameter.

F. Down pressure shall be applied to uniformly advance the pile a distance equal to the pitch of the helix section per revolution.

G. Extension sections shall be provided to the helix section in order to obtain the minimum embedment depth and/or minimum effective torsional resistance as indicated on the approved shop drawings. Connect sections together in strict accordance with the approved shop drawings and the manufacturer's criteria.

H. Termination Criteria:

1. The measured torque during installation shall not exceed the torsional strength rating of the central steel shaft.

2. The minimum installation torque and/or the minimum overall length criteria as shown on the approved shop drawings shall be satisfied prior to terminating the installation of any given helical pile.

3. The minimum installation torque shall be the average torque for the last reading of each of the last three feet of penetration.

4. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving any required minimum overall length, the contractor shall complete the following:

a. Remove the existing helical pile and discard.

b. Install a new pile with higher torsional strength rating or with fewer or smaller diameter helix plates. The new pile configuration shall be submitted for approval

c. The replacement piles shall be installed to an embedment at least three helix diameters, but not less than three feet beyond the position of the previously removed pile without exceeding any maximum embedment length requirements and achieving the minimum required torsional resistance.

5. If the minimum effective torsional resistance is not met by the time any specified minimum embedment length is achieved the contractor shall complete one of the following:

a. Continue installing the pile to a greater depth until the minimum effective torsional resistance is achieved without exceeding any maximum embedment length requirement.

b. Demonstrate acceptable pile performance through proof testing.

c. Remove the pile and replace with one having more or larger diameter helix placed. The new pile configuration shall be submitted for approval.

1) The replacement piles shall be installed to an embedment at least three helix diameters, but not less than three feet beyond the position of the previously removed pile without exceeding any maximum embedment length requirements and achieving the minimum required torsional resistance.

6. If the installation reaches a specified maximum embedment length without achieving the minimum effective torsional resistance the contractor shall complete one of the following:

a. Demonstrate acceptable pile performance through proof texting

b. De-rate the load capacity of the pile and install additional piles as required to meet the design requirements.

1) The de-rated capacity shall be subject to the approval of the Architect

2) The location of additional piles call be subject to the approval of the Architect.

3) The cost for modifications to foundations, whether new or existing to accommodate the new pile configuration shall be the responsibility of the contractor.

4) The cost for additional piles shall be the responsibility of the contractor.

I. If a helical pier is refused or defected by an subsurface obstruction the installation shall be terminated and the pile removed. The obstruction shall be removed if feasible, and the pile reinstalled. If the obstruction can't be removed the pile and/or additional piles shall be installed at adjacent location(s) as directed by the architect.

1. The cost for modifications to foundations, whether new or existing to accommodate the new pile configuration shall be the responsibility of the contractor.

2. The cost for additional piles shall be the responsibility of the contractor.

J. If minimum embedment length has been meet, but the torsional strength rating of the plie or the installation equipment has been reached prior to proper positioning of the last plain extension section relative to final elevation the contractor shall complete one of the following:

1. Remove the last plain extension and replace it with a shorter length section. The pile shall NOT be reversed to facilitate removal of the extension.

2. If it is not feasible to remove the last plain section the contractor may cut off the section to the correct elevation, and provide an alternate pile butt connection detail. The alternate detail shall be submitted for approval.

K. Installation Tolerances: Install piles without exceeding the following tolerances, measured at pile heads:

1. Location: 3 inches from specified location, the maximum adjustability load transfer devices and connection hardware, or the maximum offset accounted for in the design of load transfer and connection hardware, whichever is less

2. Inclination Angle: Maintain shaft alignment within 2 degrees of specified angle.

3. Cutoff elevation: Shall not be higher than, and not more than 2 inches below the specified design elevation

4. Where pile layout is part of the performance based submittal the placement, alignments and their respective tolerances shall be part of the design submittal.

L. If a helical pile fails quality control criteria for any reason, the proposed remedy is subject to the approval of the architect prior to implementing the remedy. It shall be the burden of the contractor to substantiate the remedy to the architect.

M. Withdraw damaged or defective piles and piles that exceed driving tolerances and install new piles within driving tolerances.

N. As-Built Survey: Contractor shall provide an as-built survey to the engineer of record. The survey shall show all piles with deviations from theoretical pile location, pile alignment and pile butt elevation. All pile locations, alignments and cutoff elevations that are not within tolerance shall be specifically noted.

1. Foundation work should not commence until the as-built survey has been reviewed and/or approved and/or associated foundation revisions have been issued to account for any out of tolerance piles.

O. Additional pile and/or foundation work as the resultant of defective or out of tolerance piles shall be completed at no additional cost or time penalty to the owner.

P. The cost of additional analysis and design of piles and/or foundations as the resultant of defective or out of tolerance pile shall be the responsibility of the contractor and reimbursed to the owner as a change order to the contract.

3.3 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 in accordance with the schedule of special inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

3.5 DISPOSAL

A. Remove withdrawn piles and cutoff sections of piles from site and legally dispose of them off Owner's property.

B. Do not reuse test piles or piles that have been withdrawn due to failure to meet criteria.

END OF SECTION 316612

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aggregate subbase.
2. Aggregate base course.

1.2 SUBMITTALS

A. Product Data:

1. Geotextile fabric, if applicable.

B. Materials Source: Name of aggregate materials suppliers.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout Work.

B. Perform Work according to SCDOT standards.

PART 2 - PRODUCTS

2.1 AGGREGATE MATERIALS

A. Subbase Aggregate: ASTM D2940; graded type, in accordance with SCDOT standards.

1. Percent Passing per Sieve Size:

B. Base Aggregate: ASTM D2940; graded type, in accordance with SCDOT standards.

2.2 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted substrate is dry and ready to support paving and imposed loads.

1. Proof-roll substrate with 4-wheeled, rubber-tired truck weighing a minimum of 25-tons in a minimum of two perpendicular passes to identify soft spots.
2. Remove soft substrate and replace with compacted fill as specified in Section 312323.

B. Verify substrate has been inspected, gradients and elevations are correct.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place fill on soft, muddy, or frozen surfaces.

3.3 AGGREGATE PLACEMENT

A. Install geotextile fabric over subgrade according to manufacturer's instructions, if required.

1. Lap ends and edges minimum 6 inches.
2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.

B. Level and contour surfaces to elevations, profiles, and gradients indicated.

C. Maintain optimum moisture content of fill materials to attain specified compaction density.

D. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

A. According to SCDOT standards.

3.5 FIELD QUALITY CONTROL

A. Compaction testing will be performed according to SCDOT standards.

B. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

C. Frequency of Tests: One test for every 1,000 sq yd or less of each layer compacted aggregate.

3.6 COMPACTION

A. Compact materials to maximum density as required by SCDOT standards.

END OF SECTION 32 11 23

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.

1.2 SUBMITTALS

A. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

1.3 QUALITY ASSURANCE

A. Mixing Plant: Conform to SCDOT standard.

B. Obtain materials from same source throughout.

C. Perform Work in accordance with SCDOT standard.

D. Maintain one copy of each document on site.

1.4 AMBIENT CONDITIONS

A. Do not place asphalt when ambient air or base surface temperature is less than specified by SCDOT standard or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 ASPHALT PAVING

A. Asphalt Materials:

1. Asphalt Cement: In accordance with SCDOT standards.
2. Primer: In accordance with SCDOT standards.
3. Tack Coat: In accordance with SCDOT standards.

4. Oil: In accordance with SCDOT standards.

B. Aggregate Materials:

1. Coarse Aggregate: Crushed stone, gravel, or blast furnace slag. In accordance with SCDOT standards.
2. Fine Aggregate: Natural sand or sand manufactured from stone, gravel, or blast furnace slag. In accordance with SCDOT standards.
3. Mineral Filler: Finely ground mineral particles, free of foreign matter. In accordance with SCDOT standards.

2.2 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with SCDOT.

1. Base Course: Type A
2. Binder Course: Type C
3. Wearing Course: Type C.

C. Surface Slurry: ASTM D3910, Type 2; emulsified asphalt slurry.

2.3 ACCESSORIES

A. Sealant: Hot applied type. In accordance with SCDOT standards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify gradients and elevations of base.

B. Verify compacted subgrade is dry and ready to support paving and imposed loads.

3.2 INSTALLATION

A. Subbase

1. Aggregate Subbase: Install and prepare subbase in accordance with SCDOT standards.

B. Primer

1. Apply primer on aggregate base in accordance with SCDOT standards.
2. Use clean sand to blot excess primer.

C. Tack Coat

1. Apply tack coat in accordance with SCDOT standards.
2. Apply tack coat to contact surfaces of curbs, gutters, previously constructed asphalt or Portland cement concrete pavement.
3. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

D. Single Course Asphalt Paving

1. Install Work in accordance with SCDOT standards.
2. Place asphalt within 24 hours of applying primer or tack coat.
3. Place asphalt wearing course to compacted thickness indicated on Drawings.
4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

E. Double Course Asphalt Paving

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to compacted thickness indicated on plans.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to compacted thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Surface Slurry

1. Install uniform thickness surface slurry over existing paving in accordance with ASTM D3910.
2. Allow slurry to cure.
3. Roll paving to achieve uniform surface.

3.3 TOLERANCES

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

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

C. Variation from Indicated Elevation: Within 1/2 inch.

3.4 FIELD QUALITY CONTROL

A. Take samples and perform tests including mat density tests in accordance with SCDOT standards.

B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.

D. Asphalt Paving Density: ASTM D1188 or ASTM D2726; test one core sample from every 1000 square yards or less of compacted paving.

E. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards or less of compacted paving.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete paving for:

a. Concrete sidewalks.
b. Concrete curbs and gutters.
c. Concrete median barriers
d. Concrete parking areas and roads.
e. Concrete loading dock aprons

1.2 SUBMITTALS

A. Product Data:

1. Submit data on concrete materials, joint filler, admixtures, curing compounds.

B. Design Data:

1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Perform Work in accordance with SCDOT standards, within road right-of-way.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Aggregate Base Course: As specified in Section 321123.

2.2 CONCRETE PAVING

A. Form Materials:

1. Wood or Steel form material, profiled to suit conditions.
2. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, ½ inch thick.

B. Reinforcement:

1. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars, uncoated finish. Use galvanized finish only where shown on plans.
2. Welded Plain Wire Fabric: ASTM A185/A185M; in flat sheets; unfinished.
3. Dowels: ASTM A615/A615M; 60 ksi yield strength, plain steel bars; cut to length indicated on Drawings, square ends with burrs removed; unfinished.
4. Tie Wire: Minimum 16 gage annealed type.

C. Concrete Materials:

1. Cement: ASTM C150, Type I – Normal Portland type; gray color.
2. Fine and Coarse Aggregates: ASTM C33, Class 4M.

    a. Maximum Size: ¾ inch.

3. Water: ASTM C94/C94M; potable.
4. Air Entrainment: ASTM C260.
5. Chemical Admixture: ASTM C494/C494M.

    a. Type A - Water Reducing.

6. Fly Ash: ASTM C618 Class F or C.

7. Slag: ASTM C989; Grade 100; ground granulated blast furnace slag.

8. Plasticizing: ASTM C1017/C1017M Type I, plasticizing, Type II, plasticizing and retarding.

2.3 FABRICATION

A. Fabricate reinforcing in accordance with CRSI Manual of Practice and SCDOT standards.

2.4 CONCRETE MIX

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

B. Furnish concrete with the following characteristics:

1. Compressive Strength at 28 days: 3,000 psi or as noted on plans.
2. Maximum water/cement ratio: 0.45.
3. Slump: 3 inches maximum.
4. Air Entrainment: ASTM C94/C94M; for moderate exposure condition; maximum variation of 1.5 percent from required air content.
5. Limit the following cementitious materials to maximum percentage by mass of all cementitious materials:

    a. Fly Ash and Blast Furnace Slag: 50 percent.

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

D. Use set retarding admixtures during hot weather only when approved by the Engineer in writing.

2.5 FINISHES

A. Shop Finishing - Reinforcement:

1. Galvanized Finish for Steel Bars: ASTM A767/A767M, Class II, hot dip galvanized after fabrication.

2.6 ACCESSORIES

A. Curing Compound: ASTM C1315 Type and Class are as follows:
1. Type I – Clear or translucent.
2. Class A – Non-yellowing.

B. Membrane Curing and Sealing Compound: ASTM C1315 Type I, Class A.

C. Surface Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

D. Joint Sealant: ASTM D6690, Type I; hot applied type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify gradients and elevations of base.

B. Verify compacted subgrade, granular base or stabilized soil is ready to support paving and imposed loads.

3.2 PREPARATION

A. Moisten substrate to minimize absorption of water from fresh concrete.

3.3 INSTALLATION

A. Forms:

1. Place and secure forms to correct location, dimension, and profile.
2. Place joint filler in joints, vertical in position, in straight lines. Secure to formwork.
3. Place expansion and contraction joints as indicated on drawings. Align joints.
4. Place joint filler between paving components and other appurtenances.

B. Reinforcement:

1. Place reinforcing as indicated on drawings.
2. Interrupt reinforcing at expansion joints. Lubricate one-half of dowel to prevent bond to concrete on one side of joint.
3. Place dowels and reinforcing to achieve paving and curb alignment as detailed.

4. Provide doweled joints at 15 inch spacing at transverse joints or interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.

C. Placing Concrete:

1. Place concrete in accordance with ACI 301.
2. Do not disturb reinforcing or formwork components during concrete placement.
3. Place concrete continuously between predetermined joints.

D. Finishing:

1. Area Parking, Road, Loading Dock Aprons, Refuse Dumpster Pad Paving: Wood float.
2. Sidewalk and all other Concrete Surfaces: Wood float unless directed otherwise by Owner or in drawings.
3. Apply curing compound on exposed concrete surfaces immediately after finishing.

3.4 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.

B. Maximum Variation from True Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Perform field inspection and testing in accordance with ASTM C94/C94M, ACI 301 and SCDOT standards.

B. Inspect reinforcing placement for size, spacing, location, support.

C. Testing firm will take cylinders and perform slump and air entrainment tests in accordance with ACI 301.

D. Strength Test Samples:

1. Sample concrete and make one set of three cylinders for every 75 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area paving.
2. Make one additional cylinder during cold weather concreting, and field cure.

E. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M and ASTM C231.
3. Temperature Test Method: ASTM C1064/C1064M.

F. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.
2. Test one cylinder at 7 days.
3. Test two cylinders at 28 days.

END OF SECTION 32 13 13

SECTION 32 16 23 - SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Concrete paving for sidewalks.

1.2 SUBMITTALS

A. Product Data:

1. Information regarding concrete materials**,** joint filler, admixtures, and curing compounds.
2. Mix Design:

    a. Concrete mix design for each concrete strength prior to commencement of Work.
    b. Separate mix designs if admixtures are required for hot- and cold-weather concrete Work.
    c. Identify mix ingredients and proportions, including admixtures.

3. Identify chloride content of admixtures and whether or not chloride was added during manufacture.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

A. Perform Work according to ACI301.

B. Obtain cementitious materials from same source throughout.

C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete projects complying with ASTM C 94 requirements for production facilities and equipment.

D. Installer Qualifications: An experienced installer who has completed pavement work 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials according to manufacturer instructions.

B. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.5 AMBIENT CONDITIONS

A. Minimum Conditions: Do not place concrete if base surface temperature is less than 40 deg. F, or if surface is wet or frozen.

B. Subsequent Conditions: Maintain minimum 50 deg. F, for not less than 72 hours after placing, and at a temperature above freezing for remainder of curing period.

1.6 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBGRADE

A. As specified in Section 321123 - Aggregate Base Courses.

2.2 MATERIALS

A. Forms:

1. Material:

a. Wood: Straight and free from warping, twisting, loose knots, splits, or other defects.
b. Steel: Channel-formed sections.

2. Profile: To suit conditions.
3. Joint Filler:

a. Material: Asphalt-impregnated fiberboard or felt.
b. Comply with ASTM D1751.
c. Thickness: 1/2 inch.

B. Reinforcement:

1. Deformed Reinforcing:

a. Steel: Comply with ASTM A615/A615M.
b. Yield Grade: 60 ksi.
c. Billet Bars: Deformed.
d. Finish: Uncoated. Use galvanized finish only where shown on plans.

2. Deformed Bar Mats:

a. Description: Steel bars.
b. Comply with ASTM A184/A184M.
c. Fabrication: Comply with ASTM A706/A706M.
d. Yield Strength: 60 ksi.
e. Finish: Uncoated.

3. Welded Plain-Wire Fabric:

a. Comply with ASTM A1064/A1064M.
b. Configuration: Flat sheets.
c. Finish: Uncoated.

4. Dowels:

a. Description: Plain steel bars.
b. Comply with ASTM A615/A615M.
c. Yield Strength: 60 ksi.
d. Length: As indicated.
e. Ends: Square, with burrs removed.
f. Finish: Uncoated.

5. Tie Wire:

a. Type: Annealed.
b. Minimum Size: 16 gage.
c. Finish: Uncoated.

6. Epoxy Coating Patching Material: Type as recommended by coating manufacturer.

C. Concrete:

1. Cement:

a. Comply with ASTM C150/C150M.
b. Type: I portland.
c. Color: Gray.

2. Fine and Coarse Aggregates:

a. Comply with ASTM C33/C33M.
b. Class: 4M.
c. Coarse Aggregate Maximum Size: 3/4 inch.

3. Water:

a. Description: Potable.
b. Comply with ASTM C94/C94M.

4. Air Entrainment: Comply with ASTM C260/C260M.
5. Chemical Admixtures:

a. Comply with ASTM C494/C494M.
b. Type: A.

6. Fly Ash:

    a. Comply with ASTM C618.
    b. Class: F or C.

7. Slag:

    a. Description: Ground-granulated blast-furnace slag.
    b. Comply with ASTM C989/C989M.
    c. Grade: 100 or 120.

8. Plasticizing:

    a. Comply with ASTM C1017/C1017M.
    b. Type: I or II.

2.3 FABRICATION

A. Reinforcing:

1. Comply with CRSI Manual of Practice.

B. Hooks:

1. As indicated.
2. Type:

    a. Standard 90-degree bends.
    b. Seismic.

2.4 MIXES

A. Concrete:

1. Comply with ASTM C94/C94M, Option A.
2. Mix Design:

    a. Compressive Strength: 3000 PSI at 28 days, or as noted on plans.
    b. Slump: 3 inch maximum.
    c. Maximum Water/Cement Ratio: 0.45.
    d. Air Entrainment:

        1) Comply with ASTM C94/C94M.
        2) Exposure Condition: Moderate.
        3) Maximum Variation from Required Air Content: 1.5 percent.

3. Limit following cementitious materials to maximum percentage by weight of combined cementitious materials:

    a. Fly Ash and Blast-Furnace Slag: 50 percent.

4. Admixtures:

    a. Use accelerating admixtures in cold weather only if approved by Engineer in writing.
    b. Use of admixtures will not relax cold-weather placement requirements.
    c. Use calcium chloride only if approved by Engineer in writing.
    d. Use set-retarding admixtures during hot weather only if approved by Engineer in writing.

2.5 ACCESSORIES

A. Curing Compound:

1. Comply with ASTM C1315.
2. Type: I.
3. Class: A.

B. Surface Retarder:
1. Waterborne monomolecular film forming, manufactured for application to fresh concrete.

C. Joint Sealers:

1. Hot Applied:

    a. Comply with ASTM D6690.
    b. Type: I.

2.6 SOURCE QUALITY CONTROL

A. Testing: Comply with ASTM C94/C94M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.

B. Verify that gradients and elevations of subgrade are as indicated.

C. Verify reinforcing placement for proper size, spacing, location, and support.

3.2 PREPARATION

A. Moisten substrate to minimize absorption of water from fresh concrete.

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

3.3 INSTALLATION

A. Subgrade:

1. As specified in Section 321123 - Aggregate Base Courses.

B. Forms:

1. Clean forms and coat with form oil each time before concrete is placed.
2. Wood Forms: Thoroughly wet with water before concrete is placed.

C. Reinforcement:

1. Place reinforcing as indicated on drawings.
2. Interrupt reinforcing at expansion joints.
3. Place dowels reinforcing to achieve indicated paving alignment as detailed.
4. Provide doweled joints at 15-inch spacing at transverse joints or interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement.

D. Placing Concrete:

1. According to ACI 301.
2. Place concrete in forms in one layer.
3. Place concrete continuously over full width of panel and between predetermined construction joints.
4. Do not break or interrupt successive pours such that cold joints occur.
5. Place concrete to pattern as indicated.

E. Joints:

1. Place continuous transverse **expansion and contraction** joints as indicated on drawings.
2. Filler:

    a. Place joint filler between paving components and building or other appurtenances.
    b. Recess top of filler 1/4 inch for sealant installation.

3. Provide scored joints at 3-foot intervals between sidewalks and curbs.
4. Saw-cut contraction joints 1/4 inch wide at optimum time after finishing, cutting one-third into depth of slab.
5. Seal joints as indicated on drawings.

F. Finishing:

1. Wood float unless directed otherwise by Owner or in drawings.
2. Ramps and stair steps: Broom perpendicular to slope.
3. Place curing compound on exposed concrete surfaces immediately after finishing.
4. Edges and Joints:

    a. Edger Radius: 1/4 inch.
    b. Spalled Corners and Edges: Clean and fill with mortar mixture and finish.

G. Curing:

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

2. Membrane Curing:

   a. Apply membrane-curing compound uniformly to exposed surface after free water has disappeared from finished surface and before concrete has dried.
   b. Apply compound in two coats, with second coat applied perpendicular to first coat.
   c. If concrete has dried, moisten dried surface and apply curing compound as soon as free water disappears.

H. Backfilling: After curing, backfill, grade, and compact adjacent disturbed area as indicated.

3.4 TOLERANCES

A. Maximum Variation of Surface Flatness: 1/4 inch in 10 feet.

B. Maximum Variation from True Position: 1/4 inch.

C. Line and Grade for Forms: 1/8 inch in any 10-foot-long section.

3.5 FIELD QUALITY CONTROL

A. Inspection and Testing:

1. Comply with ASTM C94/C94M.
2. Samples:

   a. Sampling Procedures: Comply with ASTM C172/C172M.
   b. Cylinder Molding and Curing Procedures: Comply with ASTM C31/C31M, field cured.
   c. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area paving.
   d. Make one additional cylinder during cold-weather concreting, and field cure.

3. Cylinder Compressive Strength:

   a. Comply with ASTM C39/C39M.
   b. Acceptance:

      1) Average Compressive Strength of Three Consecutive Tests: Maximum 500 psi less than specified compressive strength.

   c. Test one cylinder at seven days, and two cylinders at 28 days.
   d. Dispose of remaining cylinders if testing is not required.

4. Slump, Temperature, and Air Content:

   a. Measure for each compressive-strength concrete sample.
   b. Slump: Comply with ASTM C143/C143M.
   c. Air Content: Comply with ASTM C173/C173M and C231/C231M.
   d. Temperature: Comply with ASTM C1064/C1064M.

5. Records:

    a. Maintain records of placed concrete items.
    b. Record date, location of pour, quantity, air temperature, number of test samples taken.

3.6 PROTECTION

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

B. Do not permit traffic over paving for minimum 14 days after finishing.

C. Damaged Concrete:

1. Remove and reconstruct concrete that has been damaged for entire length between scheduled joints.
2. Refinishing damaged portion is not acceptable.
3. Dispose of damaged portions.

END OF SECTION 32 16 23

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Traffic lines and markings.
2. Legends.
3. Paint.
4. Glass beads.

1.2 SUBMITTALS

A. Product Data: Formulation for each type of paint.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

C. Test and Evaluation Reports: Indicate source and acceptance test results according to AASHTO M247.

D. Manufacturer Instructions:

1. Application temperatures, eradication requirements, application rate, line thickness, type of glass beads, and bead embedment and application rate.
2. Installation requirements, including storage and handling procedures.

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT standards.

B. Manufacturer: Company specializing in manufacturing products specified in this Section with three years' experience.

C. Applicator: Company specializing in performing Work of this Section with three years' experience and approved by manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage:

1. According to manufacturer instructions.
2. Paint:

a. Invert containers several days prior to use if paint has been stored more than two months.
b. Minimize exposure to air when transferring paint.

c. Seal drums and tanks when not in use.

B. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.5 AMBIENT CONDITIONS

A. Do not apply materials if surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

B. Do not apply exterior coatings during rain or snow if relative humidity is outside range required by paint manufacturer, or if moisture content of surfaces exceeds that required by paint manufacturer.

C. Minimum Conditions: Do not apply paint if temperatures are expected to fall below 50° deg. F within 24 hours after application.

D. Thermoplastic Compound: Do not apply unless pavement surface temperature is minimum 55° deg. F and rising.

E. Maximum VOCs: Do not exceed limit required by State or Environmental Protection Agency.

1.6 WARRANTY

A. Furnish one-year manufacturer's warranty for pavement markings.

PART 2 - PRODUCTS

2.1 PAINTED PAVEMENT MARKINGS

1. Furnish materials according to SCDOT standards.

B. Performance and Design Criteria:

1. Paint Adhesion: Adhere to road surface, forming smooth continuous film one minute after application.
2. Paint Drying: Tack free by touch as not to transfer by vehicle tires within two minutes after application.

C. Paint:

1. Description: Ready mixed, conventional, fast-dry, waterborne traffic paints.
2. Lead-free and nontoxic.
3. Furnish materials according to SCDOT standards.

D. Glass Beads:

1. Comply with AASHTO M247, Type 1.

2. Coating: Enhance embedment and adherence with paint.

E. Thermoplastic Compound:

1. Binder Component:
   a. Comply with AASHTO M249
   b. Comply with SCDOT standards.
2. Asphalt Concrete Primer:
   a. As recommended by manufacturer of thermoplastic compound.

3. Portland Cement Concrete Primer: Epoxy resin primer, as recommended by manufacturer of thermoplastic compound.

F. Raised Pavement Markers:

1. Type:
   a. Prismatic.

2. Comply with ASTM D4280.
3. Maximum Projection above Pavement Level: 2 inch.

2.2 APPLICATION EQUIPMENT

A. Paint Gun:

1. Description: Simultaneously apply parallel lines of indicated width in solid or broken patterns or various combinations of those patterns.
2. Type: Dual nozzle.

B. Bead Gun:

1. Description: Automatically dispense glass beads onto painted surface at required application rate.
2. Type: Pressurized.

C. Measuring Device: Automatically and continuously measure to nearest foot length of each line placed.

D. Paint Heater: Capable of heating paint to 150° deg. F for fast-dry applications.

2.3 SOURCE QUALITY CONTROL

A. Test and analyze traffic paints according to SCDOT requirements.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not apply paint to concrete surfaces until concrete has adequately cured.

B. Agitate paint as recommended by manufacturer prior to application to ensure even distribution of pigment.

C. Maintenance and Protection of Traffic:

1. Prevent interference with marking operations and prevent traffic on newly applied markings before dry.
2. Maintain access to existing businesses and other properties requiring access.

D. Surface Preparation.

1. Clean and dry paved surfaces prior to painting.
2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.
3. Spot location of final pavement markings, as indicated, by applying pavement spots.
4. Request inspection by Architect/Engineer after placing pavement spots.

3.2 DEMOLITION

A. Remove existing markings in an acceptable manner, using methods that will cause least damage to pavement structure or surface.

B. Do not remove existing pavement markings by painting over with blank paint.

C. Repair pavement or surface damage caused by removal methods.

D. Clean and repair existing, remaining or reinstalled lines and legends.

3.3 APPLICATION

A. Application Rate:

1. Reflective Markings:

a. Paint: As needed to provide a wet film thickness of 15 mils.
b. Glass Spheres on Wet Paint: 6 lb./gal.

2. Nonreflective Markings:

a. Paint: As needed to provide a wet film thickness of 15 mils.

3. Thermoplastic Compound:

a. After surface preparation has been completed, prime pavement surface with spray equipment and allow primer materials to dry to a tack-free condition according to thermoplastic manufacturer recommendations.

b. Apply thermoplastic at temperature according to thermoplastic manufacturer recommendations.
c. Apply reflective glass spheres mechanically at rate of 8-10 lb./100 sq. ft.
d. Application Thickness: Not less than 90 mils and not more than 125 mils as indicated.

B. Painting:

1. Apply paint pneumatically, using guidelines and templates as necessary to control application.
2. Manually paint numbers, letters, and symbols.
3. Prevent splattering and overspray when applying markings.
4. Paint Guns: Simultaneously apply paint binder at uniform specified rates.
5. Dispense at ambient temperature.
6. Wet-Film Thickness:

a. 15 mils.
b. Edge Markings: 15 mils.

C. Reflective Media:

1. Immediately follow paint application.
2. Bead Guns:

a. Dispense glass beads simultaneously at specified rate.
b. Check guns by dispensing glass beads into gallon container for predetermined fixed period of time.
c. Verify weight of glass beads.

D. Thermoplastic Compound:

1. Place on dry pavement.
2. Apply centerline, skip line, edge line, and other longitudinal type markings with mobile applicator.
3. Place special markings, crosswalks, stop bars, legends, arrows, and similar patterns with portable applicator.

E. Raised Pavement Markers:

1. Align prefabricated markers and permanently fix in place by means of epoxy adhesives.
2. Prior to applying adhesive, thoroughly clean area by water blasting and by compressed air.

F. Dimensions and Locations: As indicated.

G. Crosswalks, Intersections, Stop Lines, Legends:

1. Use walk-behind stripers, hand spray, or stencil trucks.
2. Do not use hand brushes or rollers.
3. Glass beads may be applied by hand.

3.4 FIELD QUALITY CONTROL

A. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.

B. Acceptance:

1. Repair lines and markings which after application and curing do not meet following criteria:

a. Incorrect location.
b. Insufficient thickness, width, coverage, or retention.
c. Uncured or discolored material.
d. Insufficient bonding.

3.5 CLEANING

A. Collect and legally dispose of residues from painting operations.

3.6 PROTECTION

A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free.

B. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free.

C. If vehicle crosses a marking and tracks it, or if splattering or overspray occurs, eradicate affected marking and resultant tracking and apply new markings.

D. Follow manufacturer instructions or use minimum of 30 minutes of dry time.

E. Barrier cones are satisfactory protection for materials being dried.

3.7 MAINTENANCE

A. Provide service and maintenance of traffic paints for three years from date of Substantial Completion.

END OF SECTION 32 17 23

SECTION 32 17 26 - TACTILE WARNING SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Tactile warning surfacing and accessories.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's information including characteristics, dimensions, domes, and special shapes.

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

C. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT and local municipality standards.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and protect materials according to manufacturer's instructions.

1.5 WARRANTY

A. Furnish five-year manufacturer's warranty for tactile warning surfacing.

PART 2 - PRODUCTS

2.1 TACTILE WARNING SURFACING

1. Furnish materials according to SCDOT and local municipality standards.

B. Description:

1. ADA-compliant tactile warning surfaces for visually impaired pedestrians.
2. Suitable for installation on both asphalt and concrete.

C. Design and Performance Criteria:

1. Loading: Single-wheel HS20-44, according to AASHTO HB-17.
2. Resistant to impacts, wear, freeze-thaw, UV exposure, and stains.

3. Fire Spread: Less than 15 when tested according to ASTM E84.
4. Slip Resistance: 0.90, according to ASTM E303.
5. Taber Abrasion: 150 mgs, according to ASTM D1044.
6. Durometer Hardness: 90, according to ASTM D2240, Type A.
7. Water Absorption:

    a. Comply with ASTM D570.
    b. Maximum: 0.05 percent.

8. Minimum Strengths:

    a. Compressive: 30,000 psi, according to ASTM D695.
    b. Flexural: 18,000 psi, according to ASTM D790.
    c. Tensile: 19,000 psi, according to ASTM D638.

9. Slip Resistance:

    a. Dry: 1.03.
    b. Wet: 0.83.
    c. Comply with ASTM C1208.
    d. Wheelchair Safety: Furnish minimum 40, 90-degree raised points per sq. in.

10. Domes:

    a. Spacing: 2.35 inches, o.c., measured diagonally.
    b. Size: 0.90-inch base bottom diameter, 0.45-inch top diameter, 0.20 inches high.

D. Surface-Applied Mat Type:

1. Material: **Polyurethane**.
2. Adhesive: Pre-applied.
3. Edges: Beveled.
4. Size: 2’ by 4 feet minimum.
5. Depth: 1/4 inches.
6. Face Thickness: 1/8 inch.
7. Color: Yellow, unless otherwise specified in the plans. Must provide contrast between the adjacent materials.
8. Anchors: Stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate is level or to correct grade, is smooth, is capable of supporting tactile warning surface units and imposed loads and is otherwise ready to receive Work of this Section.

3.2 PREPARATION

A. Maintenance and Protection of Traffic:
1. Prevent interference with operations.
2. Maintain travel lanes between 7:00 AM to 9:00 AM and between 4:00 PM and 6:00 PM.

3. Maintain access to existing businesses and other properties requiring access.

B. Surface Preparation:

1. Clean and dry paved surface prior to installing tactile warning surface modules.
2. Blow or sweep surface free of dirt, debris, oil, grease, or gasoline.

C. Existing Work:

1. Remove existing tactile warning surface modules by methods that will cause least damage to pavement surface.
2. Repair pavement or surface damage caused by removal operations.

3.3 INSTALLATION

A. Install tactile warning surfacing according to manufacturer's instructions.

B. Installation Standards: Install Work according to SCDOT and local municipality standards.

3.4 FIELD QUALITY CONTROL

A. Inspect for correct location, extent of coverage, and final grade.

3.5 CLEANING

A. Clean tactile warning surfacing according to manufacturer's instructions.

3.6 PROTECTION

A. Protect tactile warning surfacing from vehicular and pedestrian traffic on newly installed tactile warning surface modules for period of time as instructed by manufacturer.

3.7 MAINTENANCE

A. Furnish service and maintenance of tactile warning surfacing for three years from date of Substantial Completion.

END OF SECTION 32 17 26

SECTION 32 91 13 - SOIL PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil.
2. Soil testing.
3. Placing topsoil.

1.2 SUBMITTALS

A. Minimum 10 oz sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

B. Test Reports: Indicate topsoil nutrient and pH levels with recommended soil supplements and application rates.

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

1.3 QUALITY ASSURANCE

A. Perform Work according to SCDOT, SCDHEC, and local municipality standards.

1.4 COORDINATION

A. Coordinate with installation of underground sprinkler system piping and watering heads.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Topsoil: As specified in Section 310513.

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained Site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

2.2 ACCESSORIES

A. Edging: As specified in plans.

2.3 SOURCE QUALITY CONTROL

A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, limestone, soluble salt content, organic matter content, and pH value.

B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

C. Testing not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify prepared soil base is ready to receive Work of this Section.

3.2 PREPARATION OF SUBSOIL

A. Prepare sub-soil to eliminate uneven areas and low spots. Maintain lines, levels, profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated sub-soil.

C. Scarify subsoil to depth of 3 inches where topsoil is to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted sub-soil.

3.3 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 4 to 6 inches as specified in plan over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install edging at periphery of seeded areas in straight lines to consistent depth.

END OF SECTION 32 91 13

SECTION 32 91 19 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Final grade topsoil for finish landscaping.

1.2 SUBMITTALS

A. Samples: In air-tight containers, 10 lb. sample of each type of fill to testing laboratory.

B. Materials Source: Furnish name of imported materials source.

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

1.3 QUALITY ASSURANCE

A. Furnish each topsoil material from single source throughout Work.

B. Perform Work according to SCDOT, SCDHEC, and local municipality standards.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Topsoil: As specified in Section 310513**.**

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building and trench backfilling have been inspected.

B. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1/2 inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, sodding, and planting is indicated and to thickness as scheduled. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, building, walkway, pavement, and curbs to prevent damage.

E. Lightly compact and roll placed topsoil.

F. Remove surplus subsoil and topsoil from Site.

G. Leave stockpile area and Site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

A. Compacted topsoil thicknesses:

1. Seeded Grass: 6 inches.
2. Sod: 4 inches.
3. Shrub Beds: 18 inches.
4. Flower Beds: 12 inches.
5. Planter Boxes: To within 3 inches of box rim.

END OF SECTION 32 91 19

SECTION 32 92 19 - SEEDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fertilizing.
2. Seeding.
3. Hydroseeding.
4. Mulching.
5. Maintenance.

1.2 DEFINITIONS

A. Weeds: Include dandelion, jimsonweed, quack grass, horsetail, morning glory, rush grass, mustard, lamb's quarters, chickweed, cress, crabgrass, Canadian thistle, nut grass, poison oak, blackberry, tansy ragwort, Bermuda grass, Johnson grass, poison ivy, nut sedge, nimble will, bindweed, bent grass, wild garlic, perennial sorrel, and brome grass.

1.3 SUBMITTALS

A. Product Data: Seed mix, fertilizer, mulch, and other accessories.

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

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.5 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Perform Work according to SCDOT, SCDHEC, and local municipality standards.

C. Seed Supplier: Company specializing in manufacturing products specified in this Section with three years' experience.

D. Installer: Company specializing in performing Work of this Section and with a record of successful grass establishment.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.7 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement until grass is well established and exhibits vigorous growing condition, but not less than 60 days after the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

A. Grass Seed: Fresh, clean, dry, Blue-Tag certified seed complying with the Official Crop Certifying Agency of South Carolina.

B. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on Schedules in Plans.

2.2 ACCESSORIES

A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Fertilizer: Commercial grade; recommended for grass; of proportion necessary to eliminate deficiencies of topsoil, as indicated in soil analysis from a qualified soil-testing agency. If soil testing is not conducted, provide soil amendments within the parameters documented in Section 3.7.

C. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

D. Water: Clean, fresh and free of substances or matter capable of inhibiting vigorous growth of grass.

E. Erosion Fabric: As specified in Plans.

F. Herbicide: EPA registered and approved, of type recommended by manufacturer.

G. Stakes: Softwood lumber, chisel pointed.

H. String: Inorganic fiber.

2.3 SOURCE QUALITY CONTROL

A. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

C. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify prepared soil base is ready to receive Work of this Section.

3.2 FERTILIZING

A. Apply lime at application rate recommended by soil analysis. Work lime into top 6 inches of soil.

B. Apply fertilizer at application rate recommended by soil analysis.

C. Apply after smooth raking of topsoil and prior to roller compaction.

D. Do not apply fertilizer at same time or with same machine used to apply seed.

E. Mix fertilizer thoroughly into upper 2 inches of topsoil.

F. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

3.3 SEEDING

A. Apply seed at rate indicated in the planting schedule, evenly in two intersecting directions. Rake in lightly.

B. Do not seed areas in excess of that which can be mulched on same day.

C. Planting Season: As recommended by manufacturer.

D. Do not sow immediately following rain, when ground is too dry, or when winds are over 12 mph.

E. Roll seeded area with roller not exceeding 112 lb./linear ft.

F. Immediately following seeding and compacting, apply mulch to thickness of 1/8 inch. Maintain clear of shrubs and trees.

G. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

A. Apply fertilizer, mulch and seeded slurry with hydraulic seeder at rate of 35 lb. per 1,000 sq ft evenly in one pass.

B. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels 2 to 4 inches.

3.5 SEED PROTECTION

A. Identify seeded areas with stakes and string around area periphery. Set string height to 6 inches. Space stakes at 60 inches.

B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 36 inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

F. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.6 MAINTENANCE

A. Mow grass at regular intervals to maintain at maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.

B. Neatly trim edges and hand clip where necessary.

C. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.

D. Water to prevent grass and soil from drying out.

E. Roll surface to remove minor depressions or irregularities.

F. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.

G. Immediately reseed areas showing bare spots.

H. Repair washouts or gullies.

I. Protect seeded areas with warning signs during maintenance period.

3.7 PLANTING SOIL AMENDMENTS SCHEDULE

A. Lawns: Provide soil amendments required to provide planting medium within the following parameters:
   1. Soil pH range: 5.8 – 6.2.
   2. Phosphorus index of 50; equivalent to 60 ppm P (137 ppm P205).
   3. Potassium index of 50; equivalent to 100 ppm K (120 ppm K20).
   4. Calcium equivalent to 40 – 60 percent of Cation Exchange Capacity (CEC) (Ca%=(Ca/CEC)).
   5. Magnesium equivalent to 8 – 15 percent of CEC (Mg%=(Mg/CEC)).
   6. Base Sat equivalent to 60 – 80 percent of CEC (BS%=((Ca = Mg = K)/CEC).
   7. Manganese Index Mn-I 25 equivalent to 4.0 ppm.
   8. Zinc Index Zn-I 25 equivalent to 1.0 ppm Zn.
   9. Copper Index Cu-I 25 equivalent to 0.5 ppm Cu.

END OF SECTION 32 92 19

SECTION 32 93 00 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preparation of subsoil and topsoil.
2. Topsoil bedding.
3. Trees, plants, and ground cover.
4. Mulch.
5. Fertilizer.
6. Pruning.
7. Maintenance.

1.2 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.3 SUBMITTALS

A. Product Data: List of plant material sources, data for fertilizer and other accessories.

B. Minimum 10 oz. sample of topsoil proposed. Forward sample to a qualified independent soil testing laboratory in sealed containers to prevent contamination and provide analysis report stating percentages of organic matter, inorganic matter (silt, clay and sand), deleterious material, pH and mineral and plant-nutrient content of topsoil.

1. Report suitability of topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include pruning objectives, types and methods; types, application frequency, and recommended coverage of fertilizer; and other maintenance instructions recommending procedures to be established by owner for maintenance of landscape work during entire year.

1.5 QUALITY ASSURANCE

A. Tree Pruning: ANSI A300 Pruning Standards for Woody Plants.

B. Perform Work according to standards of agency having jurisdiction.

C. Nursery: Company specializing in growing and cultivating plants with three years' experience.

D. Installer: Company specializing in installing and planting plants with three years' experience and approved by nursery.

E. Tree Pruner: Company specializing in performing Work of this Section with three years' experience.

F. Maintenance Services: Performed by installer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

D. Plant material damaged as a result of delivery, storage or handling will be rejected.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

B. Do not install plant life when wind velocity exceeds 30 mph.

1.8 COORDINATION

A. Install plant life after and coordinate with installation of underground irrigation system piping and watering heads.

1.9 WARRANTY

A. Furnish one-year supplier's warranty for trees, plants, and ground cover.

1.10 MAINTENANCE SERVICE

A. Maintain plant life for three months after date of Substantial Completion or until maintenance instructions have been submitted, if longer.

B. Maintenance includes:

1. Cultivation and weeding plant beds and tree pits.
2. Applying herbicides for weed control. Remedy damage resulting from use of herbicides.
3. Remedy damage from use of insecticides.

4. Irrigating sufficient to saturate root system.
5. Pruning, including removal of dead or broken branches.
6. Disease control.
7. Maintaining wrapping, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.
8. Replacement of mulch.

PART 2 - PRODUCTS

2.1 TREES, PLANTS, AND GROUND COVER

A. Planting Stock:

1. Species: According to Standardized Plant Names, official code of American Joint Committee on Horticulture Nomenclature.
2. Identification: Label individual plants or each bundle of plants when tied in bundles.
3. Plants: No. 1 Grade conforming to "American Standard for Nursery Stock" of American Association of Nurserymen (AAN); well-branched, vigorous and balanced root and top growth; free from disease, injurious insects, mechanical wounds, broken branches, decay and other defects.
4. Trees: Furnish with reasonably straight trunks, well balanced tops, and single leader unless otherwise specified.
5. Deciduous plants: Furnish in dormant state, except those specified as container grown.

B. Trees, Plants and Ground Cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of Work.

2.2 SOIL MATERIALS

A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained Site; free of subsoil, clay or impurities, plants, weeds and roots; minimum pH value of 5.4 and maximum 7.0; organic matter to exceed 1.5 percent; magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 msiemens/cm in soil.

2.3 SOIL AMENDMENT MATERIALS

A. When soil tests indicate soil amendment, apply soil conditioners or fertilizers to amend soil to specified conditions.

1. Tree Fertilizer: Containing fifty percent of elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil, as indicated in analysis.

B. Peat Moss: Shredded, loose, sphagnum moss; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight, pH range of 4 to 5; moisture content of 30 percent.

C. Bone Meal: Raw, finely ground, commercial grade, minimum of 3 percent nitrogen and 20 percent phosphorous.

D. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

E. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of plants.

F. Herbicide: EPA registered and approved, of type recommended by manufacturer.

G. Pesticide: EPA registered and approved.

2.4 MULCH MATERIALS

A. Mulching Material: Organic mulch free from weeds, foreign matter detrimental to plant life, and dry as specified by Owner/Engineer or in Plans.
   1. Composted, shredded hardwood bark, dark brown in color.
   2. Pine needles.

2.5 ACCESSORIES

A. Stakes: Softwood lumber, pointed end.

B. Tree Staking and Guying Material: Flat woven, polypropylene fabric, 3/4 -inch-wide, minimum 900 lb. breaking strength. Color: White.
   1. Manufacturer: Subject to requirements, products which may be incorporated in the Work include:
      a. Deep Root Partners, LP, (800) 458-7668, Arbor Tie.
      b. Approved comparable product.

C. Membrane: 20 mil thick, water-permeable polyolefin fabric.

2.6 PLANT SOIL MIX

A. Plant Soil Mix: Uniform mixture of 1/2 part peat, 1/2 part manure or bone meal, 3 parts topsoil by volume and 1 lb. lime per cubic foot.

2.7 SOURCE QUALITY CONTROL

A. Test and analyze imported and existing topsoil.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter; and pH value.

C. Provide recommendation for fertilizer and soil amendment application rates for specified planting as result of testing.

D. Testing is not required when recent tests are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify prepared subsoil and planters are ready to receive Work.

B. Saturate soil with water to test drainage.

C. Verify required underground utilities are available, in proper location, and ready for use.

3.2 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify subsoil to depth of 3 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Dig pits and beds three times wider than plant root system.

3.3 PLACING TOPSOIL

A. Spread topsoil to minimum depth as specified in Plans over area to be planted. Rake smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install topsoil into pits and beds intended for plant root balls, to minimum thickness as specified in Plans.

3.4 FERTILIZING

A. Apply starter fertilizer at rate recommend by soil analysis.

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 2 inches of topsoil.

D. Lightly water soil to aid dissipation of fertilizer.

3.5 PLANTING

A. Place plants for best appearance for review and final orientation by Landscape Architect/Engineer.

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Set plants in pits or beds, partly filled with prepared plant mix, at minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires from top half of root ball.

E. Place bare root plant materials so roots lay in natural position. Backfill soil mixture in 6-inch layers. Maintain plant life in vertical position.

F. Saturate soil with water when pit or bed is half full of topsoil and again when full.

3.6 PLANT RELOCATION AND RE-PLANTING

A. Relocate plants as indicated and/or directed by Landscape Architect/Engineer.

B. Ball or pot removed plants when temporary relocation is required.

C. Replant plants in pits or beds, partly filled with prepared topsoil mixture, at minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires from top half of root ball.

D. Place bare root plant materials so roots lay in natural position. Backfill soil mixture in 6-inch layers. Maintain plant materials in vertical position.

E. Saturate soil with water when pit or bed is half full of topsoil and again when full.

3.7 PLANT SUPPORT

A. Brace plants vertically with plant protector wrapped guys and stakes.

B. Tree Support Method per Tree Caliper:

1. 1 Inch - One stake with one tie.
2. 1 to 2 Inches - Two stakes with two ties.
3. 2 to 4 Inches - Three guys.
4. Over 4 Inches - Four guys.

3.8 TREE PRUNING

A. When pruning trees is required and/or permitted, lightly prune trees according to ANSI A300; Maintenance Pruning Type: Crown cleaning.

3.9 FIELD QUALITY CONTROL

A. Plants will be rejected when ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

END OF SECTION 32 93 00

SECTION 33 11 00 - WATER DISTRIBUTION SYSTEMS

NOTE: CONTRACTOR SHALL COMPLY WITH THE STANDARD WATER SPECIFICATIONS FOR THE LOCAL MUNICIPALITY. CONTRACTOR TO ONLY USE THIS SECTION OF SPECIFICATIONS TO ADDRESS THOSE ITEMS NOT COVERED IN THE LOCAL MUNICIPALITY SPECIFICATIONS.

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe and fittings.

B. Valves.

C. Hydrants.

D. Underground pipe markers.

E. Precast concrete vault.

F. Bedding and cover materials.

1.2 RELATED SECTIONS

A. Section 033000 – Cast-In-Place Concrete

Section 312316.13 – Trenching

1.3 SUBMITTALS

A. Product Data: Submit technical data and installation instructions on pipe materials, pipe fittings, valves and accessories.

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

C. Hydrostatic Testing:
1. Submit Schedule of hydrostatic testing seven days prior to testing.
2. Submit proposed method of disposal of wastewater from hydrostatic testing and disinfection water.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.

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

1.5 QUALITY ASSURANCE

A. Qualifications: At least 3 years of successful installation experience on projects with potable water piping work similar to that required for project.

B. Codes and Standards
   1. Plumbing Code Compliance
      a. Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
   2. Water Purveyor Compliance
      a. Comply with requirements of Purveyor supplying water to project. Obtain required permits and inspection.
   3. SCDHEC Compliance
      a. Comply with State Primary Drinking Water Regulations.

C. All material or products which come into contact with drinking water shall be third party certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components - Health Effects. The American National Standards Institute shall accredit the certifying party.

D. Steel pipe and asbestos cement pipe shall not be used in potable water systems.

E. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water.

F. Lubricants that will support microbiological growth shall not be used for slip-on joints. The use of vegetable shortening is prohibited.

G. The use of solvent-weld PVC pipe and fittings in water mains 4-inch and larger is prohibited.

H. Any pipe, solder, or flux which is used in the installation or repair of any public water system, used in any plumbing, which provides water through connection to a public water system, for human consumption, shall be lead free. Lead free, for solder and flux, means those containing not more than 0.2% lead. Lead free, for pipes and pipe fittings, means those containing not more than 8.0% lead. Leaded joints necessary for the repair of CIP shall be exempt from the above.

I. No flushing device shall be directly connected to any sewer.

J. Chambers, pits or manholes containing valves, blow-offs, meters, air relief valves, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer.

K. All pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to Section C of the AWWA Standards.

L. Water mains which have been previously used for conveying potable water may be reused provided they meet applicable criteria from AWWA Section C, ANSI/NSF 61, and ASTM D 1785 or D 2241. The mains must be thoroughly cleaned and restored practically to their original condition.

M. All water mains shall be provided with a minimum of 30 inches of cover, unless pipe material is ductile from, or other approved materials, and if exposed should be insulated to prevent freezing.

N. Valves: Manufacturer's name and pressure rating marked on valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers with labeling in place.

B. Equipment and spare parts must be properly protected against any damage during a prolonged period at the site.

C. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built and securely bolted.

D. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

E. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.

F. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.7 MEASUREMENT AND PAYMENT

A. No separate measurement and payment will be made for Water Utility Distribution Piping. Payment will be made in accordance with the lump sum price to which it pertains as listed on the Bid Form.

PART 2 PRODUCTS

2.1 WATER PIPING

A. Polyethylene Tubing: Pipe smaller than 2 inches shall be polyethylene tubing, SDR 7.3, and shall conform to ASTM D2737.
   1. Fittings: AWWA C901, molded.
   2. Joints: Butt fusion.

B. Ductile Iron Pipe (DIP): (Pipe 3 inches through 48 inches)
   1. Pressure Class 350. Designed in accordance with AWWA C150 and C151.
   2. Fittings: Ductile iron, 350 psi working pressure and equal thickness as joining pipe.
   3. Joints: AWWA C111, rubber gasket.
   4. Linings: Cement lining per AWWA C104.
   5. Coatings: Asphaltic coating, as per AWWA C151, approximately 1 mil thick.

C. Polyvinyl Chloride (PVC) Pipe:
   1. Pipe less than 4 inches, conform to ASTM D1785, Schedule 80:
      a. Fittings: ASTM D2466, PVC.
      b. Joints: ASTM D2855, solvent weld.
   2. Pipe 2 inches through 4 inches, conform to AST M D2241
      a. SDR 21 with minimum pressure rating of 200 psi at 73.4 degrees F

b. Hydrostatically test as AWWA C900
c. Joints shall be integral bell type and shall conform to ASTM D3139

3. Pipe 4 inches through 12 inches, conform to AWWA C900 Class 200:
   a. Fittings: AWWA C111, cast iron.
   b. Joints: ASTM D3139 compression gasket ring.
4. Pipe 12 inches through 48 inches, conform to AWWA C905 Class 200:
   a. Fittings: AWWA C111, cast iron.
   b. Joints: ASTM D3139 compression gasket ring.
5. Conform to cast iron outside diameter (CIOD) size dimensions.
6. Conform to National Sanitation Foundation (NSF) Standard 14 and be marked “NSF Approved” on the pipe.

D. Steel Piping: All steel waterline pipe shall conform to the requirements of AWWA C200 or ASTM A53 or A120.

E. High Density Polyethylene (HDPE) Pipe: HDPE waterline pipe, 4 inches through 63 inches, shall conform to the requirements of AWWA C906.

F. Joints connecting pipe of differing materials shall be made in accordance with manufacturer’s recommendation.

G. All pipe material, solder and flux shall be lead free (less than 0.2 percent lead in solder and flux and less than 8.0 percent lead in pipes and fittings).

H. Thermoplastic pipe shall not be used above grade.

2.2 FITTINGS

A. Ductile Iron (3 Inch – 48 Inches): ANSI/AWWA C 110/A 21.10. Note: Compact Ductile Iron Fittings (ANSI/AWWA C 153/A 21.53) may be substituted only in conditions with space limitations and with the concurrence of the Owner’s Representative.

B. Joints: Match pipe furnished.

C. Coating and Lining:
   1. Outside Coating: Bituminous enamel, minimum thickness 1 mil.
   2. Inside Lining: Cement mortar; ANSI/AWWA C 104/A 21.4.

2.3 FLEXIBLE EXPANSION JOINTS

A. Single ball flexible expansion joint designed for protection against bending moments.

B. Construction:
   1. Manufactured of 65-45-12 ductile iron conforming to the material requirements of ASTM A 536 and ANSI/AWWA C 153/A 21.53.
   2. Working Pressure: 350 psi for flexible joints 3 inch through 24 inch in size; 250 psi for flexible joints 30 inch and over in size.
   3. Expansion joint designed and cast as an integral part of a ball and socket type flexible joint; 4 inch minimum expansion capability.
   4. Each ball and socket capable of at least 15 degrees deflection.
   5. Coating and Lining:

a. Outside Coating: Coat tar epoxy, minimum thickness 5 mils.
b. Inside Lining and Seal Contact Surfaces: NSF approved fusion-bonded epoxy conforming to the material requirements of and tested in accordance with ANSI/AWWA C 213.

6. Joints (Mechanical Joint or Flanged Ends): Match joints of pipe furnished.
7. Pressure tested against its own restraint at rated working pressure.

C. Acceptable Manufacturer: EBAA Iron Sales, Inc., P.O. Box 857, Eastland, TX 76448.

2.4 GATE VALVES

A. 2-1/2 inches and Smaller: Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, extension box.

B. 3 inches and Larger: AWWA C509, Iron body, bronze trim, non-rising stem with square nut, single wedge, resilient seat, control rod, post indicator, extension box and valve key.

C. Gate valves shall be designed for a minimum working pressure of 250 psi (unless otherwise noted on plans).

D. Connections shall be as required for piping

E. Valves shall opened by turning counterclockwise and have a clear waterway equal to the full nominal diameter of the valve.

F. Operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

G. All gate valves shall be Underwriters Laboratories listed and Factory Mutual approved.

H. Provide one T-handle operator for each ten buried valves with nut operator.

2.5 COUPLINGS

A. Mechanical Couplings:
1. Sleeve type providing a tight flexible joint under conditions, such as pipe movements caused by expansion, contraction, slight settling of or shifting in the ground, minor variations in trench gradients, and traffic violations.
2. Couplings shall be of strength not less than the adjoining pipeline.
3. Sleeve type couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.
4. As manufactured by Dresser Manufacturing, Bradford, PA Style 138.

2.6 UNDERGROUND PIPE MARKERS

A. All water mains shall be detectable within 3 feet with electronic locating equipment.

B. Iron Pipe: Bright colored plastic ribbon type, continuously printed, minimum 4 inches wide by 4 mil thick, manufactured for direct burial service. Shall be buried at a depth of 1-1/2 feet from finished grade.

C. Plastic Pipe: Continuous 12-gauge, blue insulated, copper tracer wire. Shall be buried a minimum of 6" above top of water main.

2.7 PRECAST CONCRETE VAULT

A. Precast vault designed in accordance with ASTM C858, comprising modular, interlocking sections complete with accessories.

B. Manufactured by Tindall or approved equal.

2.8 SERVICE CLAMPS

A. Furnish with a pressure rating not less than that of the pipe.

B. Double flattened strap type.

C. Clamps shall have a galvanized malleable iron body with cadmium plated straps and nuts

D. Clamps shall have rubber gasket cemented to the body.

E. Furnish Smith-Bleir 313 or approved equal.

2.9 CORPORATION STOPS

A. Conform to AWWA C800 with copper alloy body and tapered threads

2.10 SERVICE STOPS

A. Service stops shall be waterworks inverted ground key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be bronze with female iron pipe size connections or hydrostatic test pressure not less than 200 psi.

2.11 GOOSENECKS

A. Use Polyethylene piping at higher pressure rating than connecting pipe. Length of cable and connections shall be in accordance with standard practice.

2.12 TAPPING SLEEVE AND VALVE

A. Tapping Sleeves:
   1. The ductile iron split sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve.
   2. Construction shall be suitable for a maximum working pressure of 200 psi.
   3. Bolts shall have square heads and hexagonal nuts.

B. Tapping Valves

1. Material shall be compatible with tapping sleeve and shall conform to the requirements for gate valves above.
2. Joints shall be flanged for the tapping sleeve and mechanical joint for the pipe end.

2.13 METER BOXES

A. Meter boxes shall be installed around valves with additional sections stacked above as required to bring the cover to existing grade level. All boxes shall be jumbo size meter boxes with heavy-duty lids as approved by the engineer.

B. The bottom box section shall be set on a firm bed of pea rock, which shall extend down at least 6-inches below the pipe.

C. Meter boxes shall be Carson-Brooks Model 1419-12 or equal. Cover shall be Carson-Brooks Model 1419-T or equal. Coat cover with two (2) shop coats bitumastic paint.

2.14 AIR RELIEF VALVES

A. Air Relief Valves shall be Crispin model number PL10 with ¼ inch orifice, or approved equal.

B. Provide heavy duty cast iron meter box to house valve.

2.15 FIRE HYDRANTS & POST HYDRANTS

A. General: Fire hydrants shall be provided as shown on the plans and as specified herein. Fire hydrants shall only be installed on 6” and larger pipelines capable of supporting fire flows of 500 GPM in addition to 1/5 maximum instantaneous demand. All pipelines 6” and larger shall be terminated with a fire hydrant for flushing purposes. 4” pipelines shall be terminated with a post type flushing hydrant with a single 2 ½” nozzle. All hydrants shall be equipped with an isolation valve to allow for servicing without interruption of system flows. All potable water appurtenances that contact potable water shall bear the National Sanitation Foundation (NSF) seal of approval stating compliance with ANSI/NSF Standard 61. Post type hydrants shall not be used to support or provide fire flows.

B. Materials: Shop drawings and related data shall be submitted to the ENGINEER for review.
   1. Fire Hydrants shall be the cast iron, compression type, opening against pressure, and shall conform to ANSI/AWWA C502. Hydrants shall have a minimum 6” restrained mechanical joint connections with a minimum 5-1/4” main valve. Each fire hydrant shall have two 2-1/2” hose nozzles and one 4-1/2” pumper nozzle. Post type flushing hydrant shall be equipped with a single 2-1/2” nozzle. Hose connections shall have NST threads and comply with ANSI B26, but will not have chains attaching the caps to the upper barrel. Barrel lengths shall be for a 3-1/2 FT bury, except where other lengths are necessitated by the hydrant location and approved by the Engineer. Threads and operating nuts shall be identical to that of existing hydrants on the system.
   2. Hydrants shall be furnished with an O-ring sealed reservoir located in the bonnet so that all threaded and bearing surfaces are automatically lubricated when the hydrant is operated. Hydrant nozzles shall be O-ring sealed, threaded in place, and retained by stainless steel set screws or clips. Hydrant shall have a bronze seat ring that threads into a bronze drain ring. All working parts shall be removable without disconnecting the hydrant.

3. Hydrants shall be furnished with a breakable feature designed to break cleanly upon impact and consisting of a two-part breakable safety flange or breakable lugs with a breakable stem coupling.
4. All retaining bolts and hardware shall be 316 stainless steel.
5. Upper and lower main stem rods shall be 316 stainless steel.
6. All bronze or brass internal working parts in contact with service water shall be a maximum of 16% in zinc content and 79% minimum in copper.
7. EPDM rubber shall be provided on all hydrant main valves.
8. Interior coating shall be two part thermosetting or fusion bonded epoxy coated, holiday free to a minimum thickness of 4 mil, and conforming to "AWWA C550 protective interior coating for valves and hydrants."
9. Exterior casting shall indicate type, main valve size, design, date of manufacture, and location of manufacture.
10. Exterior coating shall be factory coated as follows:
    a. Hydrant barrel, caps and bonnet shall be painted Safety Yellow (Shermann Williams – Steel Master line #9500 Code- Safety Yellow B56Y300) or as required by local authority. Exterior hydrant parts below ground shall be coated with fusion bond epoxy coating, coated holiday free to a minimum thickness of 4 mil.
    b. Developer may choose a different fire hydrant color if developer maintains fire hydrant, and color is approved by the Engineer.
11. All fire hydrant installations on paved roadways shall be provided with industry standard "blue hydrant reflector" installed in the center of the closet travel lane. Reflectors shall be SCDOT approved.
12. Fire hydrants drains shall not be connected to or located within 10 feet of sewer system.

2.16 YARD HYDRANTS

A. Yard hydrants shall be anti-freezing and equipped with the following:
    1. Double - ball check valve on the drain that is vented to atmospheric air and has Teflon balls for zero percent water absorption.
    2. Vacuum breaker permanently attached to the outlet that prevents unwanted back-siphonage from an attached hose.
    3. Acceptable Model: Model BFH M-100 as manufactured by Murdock, Inc., Cincinnati, Ohio 45204.

2.17 THRUST RESTRAINTS

A. Mega-Lug restraints manufactured by EBBA.

B. Thrust restraints shall be used on all tees, bends, and plugs on lines 2.5 inches in diameter and larger, for all post hydrants on lines 3 inches in diameter and larger, and for all hydrants on lines 6 inches in diameter and larger.

2.18 TAPS

A. Where indicated or required, pipe or fittings shall be aped to receive small pipe or special fittings. Required taps shall be furnished as part of this work. Tap shall include all bosses or other fittings as necessary to provide the size tap needed.

2.19 BEDDING AND COVER MATERIALS

A. Bedding: as specified in municipality specification for material and compaction requirements

B. Cover: See municipality specification for proper material and compaction requirements.

C. Soil Backfill from Above Pipe to Finish Grade: Subsoil with no rocks over 6 inches in diameter, frozen earth or foreign matter. Initial Backfill and final backfill shall be as specified in municipality specification.

2.20 VALVE BOXES

A. Provide at each buried valve.

B. Cast iron extension type, suitable for minimum cover of 3’6” over the pipe.

C. Minimum inside diameter at the top of 5”, minimum wall thickness 3/16”.

D. Have the word “WATER,” etc., as applicable, cast into the cover.

E. Provide Tyler Series 6850.

F. Where depth requires more than a two-piece box, use adjustable cast iron extensions.

G. Coat box and cover with two (2) shop coats of bitumastic paint.

2.21 VALVE BOX PROTECTION RING

A. Provide at each valve box a precast concrete protection ring.

B. Provide two rings of No. 3 reinforcing steel, one 14” in diameter, and one 23” in diameter.

C. Inside dimensions to be 9-1/4”.

D. Outside diameter to be 27”.

E. Provide 5” thickness at interior with a continuous slope to 2” thickness at the outside.

F. Minimum weight of 10 pounds.

PART 3 EXECUTION

3.1 PREPARATION

A. Precautions:
1. Pipe shall be installed at the locations shown on plans and to the position, alignment and grade shown on the drawings.
2. Pipe and accessories shall be handled so as to insure delivery to the trench in sound, undamaged condition.
3. Particular care shall be taken not to damage the pipe coating or lining.

4. If the coating or lining of any pipe or fitting is damaged, the repair shall be make as recommended by pipe manufacturer at the Contractor's expense.
5. No other pipe or material of any kind shall be placed inside a pipe or fitting after the coating has been applied.
6. Pipe shall be carried into position and not dragged.
7. Use of the pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe.
8. The interior of the pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method.
9. Before installation, the pipe shall be inspected for defects.
10. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Owner.
11. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.
12. Polyvinyl chloride and fittings shall be handled and stored in accordance with the manufacturers recommendations.
13. Storage facilities shall be classified and marked in accordance with NFPA 704 with classification as indicated in NFPA 49 and NFPA 325M.
14. Coated and wrapped steel pipe shall be handled in conformance with AWWA C203.

B. Cutting of Pipe
1. Cutting of pipe shall be done in a neat and clean manner without damage to the pipe.
2. Cutting shall be done with an approved type mechanical cutter.
3. Wheel cutter shall be used when practicable.
4. Copper tubing shall be cut square and all burrs shall be removed.
5. Squeeze type mechanical cutters shall not be used for ductile iron.
6. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.2 BEDDING

A. Excavate pipe trench in accordance with municipality specification for work of this Section.

B. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent maximum density.

C. Backfill around sides and to top of pipe in accordance with municipality specification.

D. Maintain optimum moisture content of fill material to attain required compaction density.

E. Place fill material in accordance with municipality specification.

3.3 PIPE INSTALLATION

A. Separation of Water Mains and Sewers: SCDHEC State Primary Drinking Water Regulation 61-58 [R.61-58.4.d, (12) (a)-(f)]

1. Parallel Installation: Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.
2. Crossings: Water mains crossing sewers shall be laid to provide a minimum vertical separation of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.
3. Water mains shall be located out of contaminated areas, unless using pipe materials that will protect the quality of the water. The line should be rerouted if at all possible.
4. If water mains are installed above grade, the pipe shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair and/or replacement.
5. Underwater Crossings – If water mains are to be placed underwater, a minimum of 2 feet cover shall be provided over the pipe. When crossing water courses that are greater than 15 feet in width, the following shall be provided:
   a. The pipe material and joints shall be designed appropriately.
   b. Valves shall be located so the section can be isolated for testing or repair and the valves on both sides of the crossing shall be easily accessible and not subject to flooding.
   c. A blow-off shall be provided on the side opposite the supply service sized in accordance with SC Regulation Section R.61-58.4 (D)(7).
   d. Use DIP with mechanical joints for any lines being installed in rock.
6. Special Conditions: When it is impossible to obtain the distances specified in R.61-58.4(D)(12)(a) and (b) the Department may allow an alternative design. Any alternative design shall:
   a. maximize the distances between the water main and sewer line and the joints of each;
   b. use materials which meet the requirements R.61-58.4(D)(1) for the sewer line; and,
   c. Allow enough distance to make repairs to one of the lines without damaging the other.
7. Force Mains: There shall be at least a 10 foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18 inch vertical separation at crossing as required in R.61-58.4(D)(12)(a) and (b).
8. Sewer Manholes: No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers ro catch basins if there is no other practical alternative, provided that ductile iron is used, no joints of the water line are within the storm sewer or catch basin and the joints are located as far as possible from the storm sewer or catch basin.
9. Drain-fields and Spray-fields: Potable water lines shall not be laid less than 25 feet horizontally from any portion of a waste-water tile-field or spray-field, or shall be otherwise protected by an acceptable method approved by the Department.

B. All visible leaks shall be repaired regardless of the amount of leakage.

C. Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electrical wiring.

D. Nonferrous Metallic Piping: Where nonferrous metallic pipe, e.g., copper tubing, crosses any ferrous piping material, a minimum vertical separation of 12 inches must be maintained between pipes.

E. Placing and laying pipe:
   1. Carefully lower pipe and accessories into the trench. Do not drop or dump into the trench.
   2. Avoid abrasion of the pipe coating.
   3. Lay pipe with bell ends facing in the direction of laying.
   4. Rest pipe solidly upon the pipe bed; with recesses for bells, couplings, and joints.
   5. Relay pip if grade or joint has been disturbed.
   6. Do not lay pipe in water or when trench conditions are unsuitable for work.
   7. Keep water out of the trench until joining is complete.
   8. Securely close open ends, of pipe, fittings, and valves when work is not in progress.
   9. Repair damaged coating or lining according to manufacturer's instructions at Contractor's expense.
   10. Valve, plug, or cap, and anchor pipe ends left for future connections.

F. Joint Deflection:
   1. Ductile Iron Pipe: The maximum allowable defection will be as given in AWWA C600.
      a. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.
   2. Flexible Plastic Pipe: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturers and approved by Engineer, but in no case shall it exceed 5 degrees.

G. Connections:
   1. Structures:
      a. Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 wall sleeves
      b. Annular space between walls and sleeves shall be filled with rich cement mortar.
      c. Annular space between pipe and sleeves shall be filled with mastic.
   2. New and existing mains:
      a. Use specials and fittings to suit actual conditions.
      b. Under pressure, connections shall be approved by Engineer.

H. Joining:
   1. Copper Tubing: Joints shall be made with flared fittings. The flared end tube shall be pulled tightly against the tapered part of the fitting by a nut which is part of the fitting, so there is metal to metal contact.
   2. Galvanize Pipe: Screw joints shall be made tight with stiff mixture of graphite and oil; inert filler and oil, or with an approved graphite compound applied with a brush to the male threads only. Do not use compounds containing lead.
   3. Ductile Iron Pipe:
      a. Mechanical and push-on type joints shall be installed in accordance with AWWA C600 for buried lines.
      b. Clean socket and plain end thoroughly, removing mud, gravel, or other foreign matter.
      c. Insert gasket into the gasket recess of the socket, large end of the gasket entering first. After gasket is in place at the bottom, the top of the gasket is positioned into the gasket recess. Warm gaskets to be installed in cold weather.
      d. Apply a thin film of lubricant to the outside pipe surface between the stripe and the end of the pipe and also the inside surface of the gasket.
      e. Do not allow pipe to touch ground or trench side after lubricating.

f. Insert plain end in the socket. Keep pipe in reasonably straight alignment. Push pipe until spigot end meets the full insertion mark.

4. PVC Pipe – Push-On
   a. Bevel ends for push-on to facilitate assembly and mark to indicate when the pipe is fully seated.
   b. Clean ring and spigot. Wipe the gasket, groove, and pipe free from foreign material.
   c. Install gasket with the flat surface facing inside the coupling, and the rounded edge facing the coupling entrance.
   d. Lower into trench slowly.
   e. Apply lubricant to gasket surface that is exposed, to the pipe spigot from the end to the full insertion mark, and the rounded edge and taper.
5. Connections between different types of pipe and accessories shall be made with transition fittings.

I. Place thrust restraints at each elbow or change of direction of pipe main.

J. Establish elevations of buried piping with not less than 3 ft of cover.

K. Install plastic ribbon tape continuous over top of pipe, 1-1/2 feet below finished grade.

L. Backfill trench in accordance with municipality specification.

M. Installation of water mains and appurtenances shall be conducted in accordance with Section C of the AWWA Standards and/or manufacturer's recommended installation procedures.

3.4 CROSS CONNECTION CONTROL (BACKFLOW PREVENTION DEVICES)

A. There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contamination materials may be discharged or drawn into the system.

B. No by-passes shall be allowed unless the by-pass is also equipped with an equal approved backflow prevention device.

C. High hazard cross connections shall require an air gap separation or approved reduced pressure backflow preventer.

D. Reduced Pressure Principle Backflow Preventer
   1. General:
      a. ¾" through 2": Use Febco Model B25Y reduced pressure backflow preventer, or approved equal.
      b. 2 ½" through 10": Use Febco Model B25YD reduced pressure backflow preventer, or approved equal.
      c. Must be on the approved list published by SCDHEC and tested by a certified tester before placing into service and two (2) copies provided to Owner.
      d. Bypasses not allowed unless equipped with an equal backflow protection.
   2. ¾" through 2" reduced pressure backflow preventers to consist of the following:
      a. Two (2) independently operating, spring-loaded, "Y" pattern check valves and one (1) hydraulically dependent differential relief valve.
      b. Designed to automatically reduce the pressure in the zone between check valves to at least 5 psi lower than inlet pressure.
      c. The differential relief valve will open and maintain proper differential should differential between upstream and the zone to drop to 2 psi.

d. Mainline valve body and caps including relief valve body and cover to be Bronze, ASTM B584-78.
e. Center stem guided check valve moving member.
f. All springs to be stainless steel, 300 series.
g. Internally locate all hydraulic sensing passages within mainline relief valve bodies and relief valve cover.
h. Diaphragm to seal area ratio to be 10:1 minimum, nitrile, fabric reinforced.
i. Removable seat ring on relief valve.
j. Construct check valve and relief valve components so they may be serviced without removing the valve body from the line.
k. Reversible, nitrile ASTM D-2000 seats.
l. Full ported ball valves for shut-off valves and test locks.
m. Rate assembly to 175 psi water working pressure and water temperature range from 32°F to 180°F.
n. Assemblies to meet requirements of ASSE Standard 1013; AWWA Standard Code C511-92, or latest revision; and USC Foundation of Cross Connection Control and Hydraulic Research, latest edition.

3. 2 ½" through 10" reduced pressure backflow preventers to consist of the following:
   a. Two (2) independent "Y" configured check valves and one (1) differential relief valve.
   b. To automatically reduce pressure in zone between check valves. Should differential between zone and upstream pressure drop to 2 psi, differential relief valve will open, maintaining proper zone differential.
   c. Series 300 stainless steel internal parts containing no dissimilar metals.
   d. Reversible elastomeric seat discs on check valves and relief valves. Seat rings to be B-61 Bronze or Series 300 stainless steel.
   e. Check assembly to be center stem guided at seat ring with replaceable non-corrosive bushings at the cover.
   f. Series 300 stainless steel relief valve spring.
   g. Design with ductile iron ASTM A-536, Grade 65-45-12 valve bodies and cover to withstand a 10:1 safety factor over rated cold water working pressure.
   h. Flanged ductile iron bodies, ANSI B16-1, Class 125, epoxy coated internally 10-20 mils.
   i. Located all orifices of the pressure sensing passages out of the normal debris flow path or settling areas.
   j. Copper, ASTM B-280 external sensing tubing.
   k. Assemblies must be flanged, full port resilient wedge shut-off valves and four vandal resistant ball valve test cocks, integral to assemblies.
   l. Factory-assembly and backflow test all assemblies.
   m. Construct assemblies so all internal parts, including seat rings, can be serviced from the top or side removed while assemblies are in line.
   n. Assemblies to be rated 175 MWWP (32°F - 140°F).

E. Double-Check Backflow Preventer
1. General:
   a. 2 ½" through 10": Use Febco Model 805YD double-check backflow preventer, or approved equal.
   b. Must be on the approved list published by SCDHEC and tested by a certified tester before placing into service and two (2) copies provided to Owner.
   c. Bypasses not allowed unless equipped with an equal backflow protection.
2. 2 ½" through 10" double-check backflow preventers to consist of the following:
   a. Two independent "Y" configured check valves.
   b. Must be spring-loaded, center stem guided type.
   c. Series 300 stainless steel integral parts.
   d. Elastomeric seat disc must be reversible.
   e. Bronze, ASTM B-61 or series 300 stainless steel seat rings bolted to valves bodies incorporating an o-ring to facilitate field removal and replacement.

f. Guide double-check assemblies at the seat ring and at the cover by replaceable non-corrosive bushings to assure positive check seating.
g. Head loss through assemblies not to exceed 5.5 psi at velocities from 0, up to and including 7.5 fps.
h. Document flow curves by independent laboratory testing.
i. Design ductile iron ASTM A536, Grade 65-45-12 valve bodies and cover to withstand 10:1 safety factor over rated cold water working pressure.
j. Ductile iron bodies flanged, ANSI B16-1, Class 125, epoxy coated internally 10-20 mils and prime coated externally.
k. Assemblies to include flanged, full port resilient wedge shut-off valves and four vandal-resistant full port ball valve test cocks, considered integral to assemblies.
l. Factory-assemble and backflow test all assemblies.
m. Construct double-check assemblies so all internal parts, including seat rings, can be serviced while in line.
n. Assemblies to be rated 175 MWWP (32°F - 140°F).
o. Assemblies to meet requirements of ASSE Standard 1015; AWWA Standard Code C510-92, or latest revision; and USC Foundation of Cross Connection Control and Hydraulic Research, latest edition.

F. Installation of Reduce Pressure Principle Backflow Preventer
1. General:
a. Minimum clearance of 12” and a maximum clearance of 30” between port and floor or grade.
b. Install where no discharge is objectionable and can be positively drained away.
c. Must be easily accessible for testing and maintenance and protected from freezing.
d. Eliminate excessive pressure situations to avoid possible damage to system and assemblies.

G. Installation of Double-Check Backflow Preventer
1. Maintain adequate clearance and easy accessibility for testing and maintenance.

3.5 VALVE INSTALLATION

A. Set valves on compacted soil.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

C. Locate valves outside the area of roads, driveways, and streets.

D. Carefully tamp earth fill around each valve box to a distance of 4 feet on all sides of the box, or the undisturbed trench face if less than 4 feet.

E. Valves after delivery shall be drained to prevent freezing and shall have interiors cleaned of all foreign matter before installation.

F. Stuffing boxes shall be tightened and the valve shall be fully opened and fully closed to insure that all parts are in working condition.

G. Installation of air release valves shall be at the high point of the line as indicated in the field.

H. The Contractor shall raise or lower existing and new valve boxes to the grades indicated on the drawings or relative to the surrounding finish grade. The frames and covers of the valve boxes which are not in paved areas or concrete areas shall be set approximately 0.1 foot above the

surrounding grade within 10 feet of the valve box and the ground shall be sloped down and away from the elevation of the cover to points 10 feet from the valve box.

I. Replace any valve boxes damaged during the Work.

3.6 FIRE HYDRANT AND POST HYDRANT INSTALLATION

A. Fire hydrants shall, in general, be set well back of the curb or ditch line at the property line, with the break ring approximately 2" above finished grade or pavement elevation.

B. Fire hydrants shall not be lifted in a manner as to damage the factory-applied coatings. Fire hydrants damaged during installation shall be rejected.

C. Each hydrant shall be connected to an individual hydrant gate valve attached to a hydrant tee on the main line. Mechanical joint restraints shall be used on all fittings. Restraint rods or thrust blocking shall not be used unless approved by the Engineer.

D. Pipeline from hydrant tee and gate valve assembly to fire hydrant shall be a minimum of 6-inch diameter and constructed of ductile iron.

E. A minimum of 2 cubic feet of crushed stone shall be placed under and around the bottom of each hydrant to facilitate drainage. Crushed stone for the hydrant foundation shall be #57 stone.

F. Hydrant drains shall not be connected or installed within 10 feet of sanitary sewer systems.

G. Raise or lower existing and new hydrants, hydrant laterals, and shut-off valves (including boxes) as required, shown, or directed. Position the steamer connections facing the road.

H. Set hydrants plumb with steamer and nozzle centerline elevations 20 inches above finished grade, or match gradeline indicated on barrel of hydrants with finished grade. Provide thrust blocks and fill in around the drip or waste outlet at the bottom of each hydrant with not less than 5 cubic feet of crushed stone. At least one half of the stone shall be below the drip or outlet and compact additional fill around the hydrant to maintain hydrant stability and to insure against shock injury to the connections.

I. Adjust hydrant laterals, if required, to provide a minimum cover of 48 inches to finished grade.

J. Provide new stand pipe extension pieces as approved and alter or provide new stems. Provide concrete thrust blocks, gaskets, and straps as required.

K. Clean and paint all parts of the hydrants showing above the ground with two coats of paint.

L. Adjust valve boxes as required.

3.7 YARD HYDRANT INSTALLATION

A. Install yard hydrant in accordance with manufacturer's instructions and recommendations.

B. Provide thrust blocks as indicated. Backfill with 2 cubic feet of crushed stone around the waste or drip outlet with 1/2 of the stone below the outlet. Arrange remaining balance of stone around

hydrant to prevent damage to the connections from mechanical shock and to insure hydrant stability.

3.8 HYDROSTATIC TESTS

A. Perform hydrostatic tests at least 5 days after installation of the concrete thrust blocking. The method proposed for disposal of wastewater from hydrostatic tests and disinfection shall be submitted to Engineer for prior approval to performing hydrostatic tests.

B. After completion of pipeline installation, including backfill, but prior to final connection to existing system, conduct, in presence of Engineer, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.

C. Provide equipment required to perform leakage and hydrostatic pressure tests.

D. Leakage Test
   1. Conduct concurrently with or after the pressure tests have been satisfactorily completed.
   2. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to 150 psi pressure or 1.5 times maximum working pressure which ever is greater.
   3. No pipeline installation will be approved when leakage is greater than that determined by the following formula:

Ductile Iron:	PVC:
$L=[SD(P)^{½}] \div 133,200$	$L = [ND(P)^{½}] \div 7,400$
L = allowable leakage (gals./hr)	L = allowable leakage (gals./hr)
S = length of the pipeline tested (feet)	N = # of joints in pipeline being tested
D = diameter of pipe (inches)	D = diameter of pipe (inches)
P = average test pressure (psig)	P = average test pressure (psig)

   4. When leakage exceeds specified acceptable rate, locate source and make repairs. Repeat test until specified leakage requirements are met.
   5. Repair all visible leaks regardless of test results.

E. Pressure Test
   1. Conduct hydrostatic test for at least two-hour duration.
   2. No pipeline installation will be approved when pressure varies by more than 5 psi at completion of hydrostatic pressure test.
   3. Before applying test pressure, completely expel air from section of piping under test. Provide corporation cocks so air can be expelled as pipeline is filled with water. After air has been expelled, close corporation cocks and apply test pressure. At conclusion of tests, remove corporation cocks and plug resulting piping openings.
   4. Slowly bring piping to test pressure and allow system to stabilize prior to conducting leakage test. Do not open or close valves at differential pressures above rated pressure.
   5. Examine exposed piping, fittings, valves, hydrants, and joints carefully during hydrostatic pressure test. Repair or replace damage or defective pipe, fittings, valves, hydrants, or joints discovered, following pressure test.
   6. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Engineer when one or more of the following conditions is encountered:
      a. Wet or unstable soil conditions in the trench.
      b. Heavily used area that would require continuous surveillance to assure safe conditions.

c. Maintaining the trench in an open condition would delay completion of the contract.

7. An unforeseeable cause which would result in excess cost.

3.9 FIELD QUALITY CONTROL

A. Compaction Testing for Bedding: In accordance with municipality specification.
   1. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Flush and disinfect system in accordance with municipality specification.

3.11 CLEANUP

A. Upon completion of the installation of the water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION 33 11 00

SECTION 33 30 00 - SANITARY SEWER SYSTEMS

NOTE: CONTRACTOR SHALL COMPLY WITH THE STANDARD SANITARY SEWER SPECIFICATIONS FOR THE LOCAL MUNICIPALITY. CONTRACTOR TO ONLY USE THIS SECTION OF SPECIFICATIONS TO ADDRESS THOSE ITEMS NOT COVERED IN THE LOCAL MUNICIPALITY SPECIFICATIONS.

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 SECTION INCLUDES

A. Sanitary sewerage system outside the building to include piping, fittings, and accessories.

B. Connection of building sanitary sewer system to Utility Service/Municipality.

C. Monolithic concrete manholes with modular precast concrete or masonry transitions to lid frames, covers, anchorages, and accessories.

D. Modular precast concrete manhole sections, with tongue-and-groove joints, with modular precast concrete or masonry transitions to lid frames, covers, anchorages, and accessories.

E. Masonry manholes with masonry transitions to lid frames, covers, anchorages, and accessories.

F. Cleanout Access and Accessories.

1.3 RELATED SECTIONS

A. Section 31 2213 – Rough Grading.

B. Section 31 2316.13 – Trenching.

1.4 DEFINITIONS

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

B. NPS: Nominal Pipe Size (Diameter).

C. ABS: Acrylonitrile-butadiene-styrene plastic.

D. EPDM: Ethylene-propylene-diene-monomer rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.5 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

B. Force-Main Pressure Ratings: At least equal to system operating pressure, but not less than 150 psig.

1.6 SUBMITTALS

A. See Division 1 Specification Sections for additional submittal procedures.

B. Product Data: For the following:

1. Pipe and Accessories: Provide data including all types of piping, pipe accessories, joints, and fittings to be used.
2. Precast Manholes: Provide data for manhole covers (lids and frames), component construction, features, configuration, joints, inserts, and dimensions.
3. Backwater valves and cleanouts.

C. Shop Drawings: Include locations, plans, elevations, details, piping with sizes and elevations of penetrations, and attachments for the following:

1. Precast concrete manholes, including frames and covers.
2. Cast-in-place concrete manholes and other structures, including frames and covers.
3. Masonry manholes and other structures, including frames and covers.

D. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

E. Coordination 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 underground structures and pipe. Show types, sizes, materials, and elevations of other utilities crossing system piping.

F. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

H. Manufacturer’s Installation Instructions: Indicate special procedures required to install Products specified.

I. Manufacturer’s Certificate: Certify that products meet or exceed requirements of these specifications and authorities having jurisdiction.

J. Project Record Documents:

1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

2. Identify and describe unexpected variations in subsoil conditions or discovery of uncharted utilities.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.8 REGULATORY REQUIREMENTS

A. Conform to all applicable local and State codes for materials and installation of the Work of this Section.

B. Conform to the conditions and requirements of the SCDHEC Construction Permit.

C. Maintain materials and surrounding air temperature to minimum 50-degrees F prior to, during, and 48-hours after completion of masonry work.

D. Cold Weather Requirements: IMIAWC – Cold Weather Masonry Construction Guide – Specifications and Recommended Practices.

E. Comply with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health DHHS (NIOSH) Publication No. 87-113, “A Guide to Safety in Confined Spaces” for all work within, or entries into, confined spaces.

1.9 PROTECTION OF EXISTING UTILITIES

A. Site Information: The approximate locations of known utilities are shown on the Drawings.

B. Site Investigation: Perform site survey, research public utility records, and verify existing utility locations. Locate the exact locations of shown utilities, and locations of any unknown utilities, within the work area using electronic pipe finder equipment or other approved methods.

C. Carefully excavate and expose existing underground utilities ahead of trenching operations.

D. Locate existing structures and piping to be closed and abandoned.

E. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the Architect/Engineer not less than two (2) days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the Architect/Engineer's written permission.
3. Repair or replace any damaged utility lines or structures to original condition at no additional cost to the Owner.

1.10 PROJECT CONDITIONS

A. Verify existing pipe sizes and invert elevations at tie-in points before commencing installation of pipe. Notify the Architect/Engineer immediately upon discovering any discrepancies from inverts shown on the Drawings.

B. Coordinate the Work with termination of sanitary sewer connections outside building, connections to Utility Service/Municipality, and trenching.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: ASTM A74, Extra Heavy or Service type, gray iron, inside nominal diameter of 4 to 12 inches, bell and spigot ends, for gasketed joints. {For use only under buildings or future building locations, unless specifically noted otherwise on the Drawings.}

1. Gaskets: ASTM C564, rubber, compression type, thickness to match class of pipe.
2. Cast-Iron pipe and joints shall comply with ANSI A21.1, A21.6, A21.8, A21.10, and/or A21.11.

B. Ductile-Iron Sewer Pipe: ASTM A746, Pressure Class 350, with cement-mortar lining, inside nominal diameter of bell and spigot ends, for push-on joints.

1. Standard-Pattern, Ductile-Iron Fittings: AWWA C110, ductile or gray iron, for push-on joints.
2. Compact-Pattern, Ductile-Iron Fittings: AWWA C153, for push-on joints.
3. Gaskets: AWWA C111, rubber.

C. Stainless-Steel Drainage Pipe and Fittings: ASME A112.3.1; ASTM A666, Type 304, stainless steel; with socket and spigot ends for gasketed joints.

1. Couplings for NPS 6 to NPS 12: Stainless steel, mechanical type, with seal.

a. Seal Material for General Applications: EPDM, unless otherwise indicated.
b. Seal Material for Fluids Containing Gasoline or Oil: Nitrile-rubber compound, unless otherwise indicated.

D. ABS Sewer Pipe and Fittings: ASTM D2751, bell and spigot ends, for solvent-cemented or gasketed joints.

1. Wall Thickness for NPS 6 to NPS 12: SDR 42.
2. Gaskets: ASTM F477, elastomeric seals.

E. PVC Pressure Pipe: AWWA C900, Class 150, for gasketed joints.

1. PVC Pressure Fittings: AWWA C907, for gasketed joints.
2. Gaskets for PVC Piping: ASTM F 477, elastomeric seals.
3. Ductile-Iron, Compact Fittings: AWWA C153, for push-on joints.
4. Gaskets for Ductile-Iron Fittings: AWWA C111, rubber.

F. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings, NPS 15 and Smaller: ASTM D3034, SDR 35, for solvent-cemented or gasketed joints.

a. Gaskets: ASTM F477, elastomeric seals.

2.2 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Pressure-Type Pipe Couplings: AWWA C219, iron-body sleeve assembly matching OD of pipes to be joined, with AWWA C111 rubber gaskets, bolts, and nuts. Include PE film, pipe encasement.

B. Ductile-Iron, Flexible Expansion Joints: 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 minimum working pressure and for offset and expansion indicated. Include PE film, pipe encasement.

C. Ductile-Iron Deflection Fittings: 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 deflection. Include PE film, pipe encasement.

D. Ductile-Iron Expansion Joints: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Include rating for 250-psig minimum working pressure and for expansion indicated. Include PE film, pipe encasement.

2.3 PE FILM, PIPE ENCASEMENT

A. ASTM A674 or AWWA C105; PE film, tube, or sheet; 8-mil thickness.

2.4 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C478, precast, reinforced concrete, of depth indicated, with provisions for rubber gasketed joints.

1. Diameter: 48-inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Gaskets: ASTM C443, rubber.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.
8. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into

base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.

9. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
10. Steps: ASTM C478, individual steps or ladder. Omit steps for manholes less than 60-inches deep.
11. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Heavy-Traffic Precast Concrete Manholes: ASTM C913; designed according to ASTM C890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to structure, as required to prevent flotation.
2. Gaskets: ASTM C443, rubber.
3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.
4. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
5. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
6. Steps: ASTM C478, individual steps or ladder. Omit steps for manholes less than 60-inches deep.
7. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

C. Cast-in-Place Concrete Manholes: Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C890 for A-16, 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: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
4. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.

D. Manhole Frames and Covers: ASTM A536, 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 "SANITARY SEWER" cast into cover.

E. Manhole Cover Inserts: Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.

1. Type: Solid.

2.5 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4,000-psi minimum, with 0.45 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A615, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4,000-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 minimum through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 4-percent minimum.

D. Ballast and Pipe Supports: Portland cement design mix, 3,000-psi minimum, with 0.58 maximum water-cementitious materials ratio.

1. Reinforcement Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A615, Grade 60, deformed steel.

2.6 MASONRY FOR MANHOLES

A. Concrete Brick Units: ASTM C55, Grade N, Type I–Moisture Controlled, Type II–Nonmoisture Controlled; normal weight, medium weight; nominal modular size of 2-1/4 x 3-5/8 x 7-5/8 –inches.

B. Mortar and Grout: Type S.

C. Reinforcement: Formed steel wire, 10/10 gage thick, galvanized finish.

2.7 PROTECTIVE COATINGS

A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:

1. Concrete Manholes: On interior surface.
2. Manhole Frames and Covers: On entire surfaces.

2.8 BACKWATER VALVES

A. Gray-Iron Backwater Valves: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.

1. Horizontal Type: With swing check valve and hub-and-spigot ends.
2. Combination Horizontal and Manual Gate-Valve Type: With swing check valve, integral gate valve, and hub-and-spigot ends.
3. Terminal Type: With bronze seat, swing check valve, and hub inlet.

B. PVC Backwater Valves: Similar to ASME A112.14.1, horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.9 CLEANOUTS

A. Gray-Iron Cleanouts: 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. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.
2. Medium Duty: In paved foot-traffic areas.
3. Heavy Duty: In vehicle-traffic service areas.
4. Extra-Heavy Duty: In roads.
5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.10 PIPE 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 as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6-inches wide and 4-mils thick, continuously inscribed with a description of 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 as follows:

1. Green: Sanitary Sewer systems.

2.11 BEDDING AND COVER MATERIALS

A. Bedding: As specified in Sections 31 2323 – Fill and 31 2316.13 – Trenching.

B. Cover: As specified in Sections 31 2323 – Fill and 31 2316.13 – Trenching.

PART 3 - EXECUTION

3.1 EARTHWORK

A. See Sections 31 1000 – Site Grading and 31 2316.13 – Trenching for additional requirements.

B. Hand trim excavations for accurate placement of pipe to elevations indicated.

C. All sewer piping shall be installed with a minimum of 3-foot of cover.

D. Backfill around sides and to top of pipe with cover fill, tamp in-place and compact, and then complete backfilling.

3.2 SEWER LINE SEPARATION GUIDELINES

A. The location of Sanitary Sewer Lines in relation to Water Lines and Other Utilities shall comply with the requirements established by SCDHEC and “Ten State Standards”.

B. When Sanitary Sewers are proposed adjacent to any existing or proposed Potable Water Supply facilities, the following shall apply:

1. Potable Water Supply Interconnections:

a. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable water supply.
b. No potable water pipes shall pass through or come into contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains:

a. Sanitary Sewers shall be laid at least 10-feet horizontally from any existing or proposed Potable Water Line.
b. In cases where it is not practical to maintain a 10-feet horizontal separation, complying with one of the following conditions may allow, upon agency approval, installation of the Sanitary Sewer closer to a Potable Water Line:

1) The Potable Water Line is installed in a separate trench.
2) The Potable Water Line is installed on an undisturbed earth shelf located on one side of the Sanitary Sewer and at an elevation so that the bottom of the Potable Water Line is at least 18-inches above the top of the Sanitary Sewer Line.

3. Crossing:

a. Sanitary Sewers crossing Potable Water Lines shall be laid to provide a minimum vertical separation of 18-inches between the outside of the Potable Water Line and the Sanitary Sewer Line.
b. Whenever possible, the Potable Water Line shall be located above the Sanitary Sewer Line.
c. Where a new Sanitary Sewer Line crosses a new Potable Water Line, a full length of pipe shall be used for both the Sanitary Sewer Line and the Potable Water Line and the crossing shall be arranged such that the joints of each line shall be as far as possible from the point of crossing and from each other.
d. Where a Potable Water Line crosses under a Sanitary Sewer Line, adequate structural support shall be provided for the Sanitary Sewer Line to prevent damage to the Potable Water Line while maintaining line and grade.

3.3 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for all underground sanitary sewer piping. Locate below finished grade, directly over piping. See Section 31 1000 – Site Grading for underground warning tapes.

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.

B. Install warning tape a minimum of 12-inches below finish grade and directly above line of pipe.

3.4 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: The following piping can be used for the appropriate sizes:

1. Cast-Iron Soil Pipe and Fittings; Hub-and-spigot; Extra-Heavy class, gaskets, and gasketed joints.

    a. Acceptable for Pipe Sizes NPS 4 to NPS 15.

2. Cast-Iron Soil Pipe and Fittings; Hub-and-spigot; Service class, gaskets, and gasketed joints.

    a. Acceptable for Pipe Sizes NPS 4 to NPS 15.

3. Ductile-Iron Sewer Pipe; standard-pattern, ductile-iron fittings; gaskets, and gasketed joints.

    a. Acceptable for Pipe Sizes NPS 4 to NPS 24.

4. Stainless-Steel Drainage Pipe and Fittings; gaskets, and gasketed joints. Use EPDM-compound gaskets, unless otherwise indicated. Use nitrile-rubber-compound gaskets for wastes containing gasoline or oil.

a. Acceptable for Pipe Sizes NPS 4 to NPS 12.

5. ABS, SDR 42, Sewer Pipe and Fittings; gaskets, and gasketed joints.

a. Acceptable for Pipe Sizes NPS 8 to NPS 12.

6. PVC Sewer Pipe and Fittings; gaskets, and gasketed joints.

a. Acceptable for Pipe Sizes NPS 4 and NPS 15.

7. PVC Sewer Pipe and Fittings; gaskets, and gasketed joints.

a. Acceptable for Pipe Sizes NPS 18 to NPS 24.

D. Force-Main Piping: Use the following:

1. Ductile-Iron Sewer Pipe; standard- or compact-pattern, ductile-iron fittings; gaskets, and gasketed joints.

a. Acceptable for Pipe Sizes NPS 3 to NPS 12.

2. PVC Pressure Pipe, PVC Pressure Fittings; gaskets, and gasketed joints.

a. Acceptable for Pipe Sizes NPS 4 to NPS 12.

3.5 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use pressure-type pipe couplings for force-main joints. Include PE film, pipe encasement.

B. Special Pipe Fittings: Use where indicated. Include PE film, pipe encasement.

3.6 INSTALLATION, GENERAL

A. Verify existing pipe sizes and invert elevations at tie-in points before commencing installation of sanitary sewer piping. Notify Architect/Engineer immediately upon discovering any discrepancies from inverts shown on the Drawings.

B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

C. Verify that trench cut and excavation base is ready to receive Work and excavations, dimensions, and elevations are as indicated on the Drawings.

D. Protect pipe, fittings, and accessories during handling against impacts and free falls. Remove extraneous materials from interior of pipe.

E. 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 piping, gaskets, seals,

sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in pipeline, and pull past each joint as it is completed.

F. Lay each pipe to slope gradients shown on the Drawings in a manner to ensure a uniform slope gradient; with a maximum variation from true slope of 1/16-inch in 10-feet.

G. Before joining pipe, make sure all contact surfaces are clean and dry. Use gasket lubricants as recommended by pipe manufacturer.

H. Place, fit, join and adjust joints to obtain watertight seal.

I. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

J. Cut-off pipe at manholes flush with interior face of manhole wall to match the shape of the manhole wall.

K. Use 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.

L. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

1. Install piping pitched down in direction of flow, at minimum slope of 2-percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover.

M. Terminate sanitary sewer piping 5’-0” from building exterior wall in locations(s) indicated. Provide temporary pipe plug for piping extending into building to be completed under Division 15 Work.

N. Install force-main piping between and connect to building's sanitary-drainage force main and termination point indicated.

1. Install piping with restrained joints at horizontal and vertical changes in direction. Use cast-in-place concrete supports and anchors or corrosion-resistant rods and clamps.
2. Install piping with 36-inch minimum cover.

O. Install ductile-iron, force-main piping according to AWWA C600.

P. Install PVC force-main piping according to AWWA M23.

Q. Install force-main piping between and connect to packaged sewage pump station outlet and termination point indicated.

R. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.7 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Hub-and-Spigot, Cast-Iron Soil Pipe and Fittings: With rubber gaskets, according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook." Use gaskets that match class of pipe and fittings.

1. Install PE film, pipe encasement over hub-and-spigot, cast-iron soil pipe and fittings according to ASTM A674 or AWWA C105.

C. Ductile-Iron Sewer Pipe with Ductile-Iron Fittings: According to AWWA C600.

1. Install PE film, pipe encasement over ductile-iron sewer pipe and ductile-iron fittings according to ASTM A674 or AWWA C105.

D. Stainless-Steel Drainage Piping: According to ASME A112.3.1 and manufacturer's written instructions.

E. ABS Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D2321.
2. Install according to ASTM D2321.

F. PE Pipe and Fittings: As follows:

1. Join pipe, tubing, and gasketed fittings with gaskets for watertight joints according to ASTM D2321 and manufacturer's written instructions.
2. Install according to ASTM D2321 and manufacturer's written instructions.
3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

G. PVC Pressure Pipe and Fittings: Join and install according to AWWA M23.

H. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with gaskets according to ASTM D2321.
2. Join profile sewer pipe fittings with gaskets according to ASTM D2321 and manufacturer's written instructions.
3. Install according to ASTM D2321.

I. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

J. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

K. Install with top surfaces of components, except piping, flush with finished surface.

3.8 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

D. Place concrete base pad, trowel top surface level and smooth.

E. Place manhole section plumb and level, trim to correct elevations, and anchor to base.

F. Install precast concrete manhole sections with gaskets according to ASTM C891. Provide rubber joint gaskets complying with ASTM C443 at joints and sections. Apply bituminous mastic coating at joints of sections.

G. Construct cast-in-place manholes as indicated.

H. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated metal items and accessories.

I. Cut and fit for pipe, conduits, sleeves, and other penetrations. Seal interface between manholes and piping (and pipe opening patch material) with epoxy bonding compound.

J. Grout base of shaft sections to achieve slope to exit piping. Trowel smooth. Contour as required.

K. Set cover frames and covers level with tipping, to correct elevations.

L. 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.

M. Install fiberglass manholes according to manufacturer's written instructions.

3.9 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.10 BACKWATER VALVE INSTALLATION

A. Install horizontal units in piping where indicated.

B. Install combination units in piping and in structures where indicated.

C. Install terminal units on end of piping and in structures where indicated. Secure units to structure walls.

3.11 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout 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.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 x 18 x 12-inches deep. Set with tops 1-inch above surrounding grade.

E. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

F. Mount lid and frame level in grout, secured to top cone section.

3.12 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. 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 3,000-psi.

C. 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 3,000-psi.

D. Make branch connections from side into existing piping, NPS 21 or larger, or to underground structures by cutting opening into existing unit 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 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.

1. Use concrete that will attain minimum 28-day compressive strength of 3,000-psi, unless otherwise indicated.
2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

E. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.13 FIELD QUALITY CONTROL

A. Perform Field Inspection and Testing in accordance with Division 1 Specification Sections.

B. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

C. 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. 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.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and re-test at no additional cost to the Owner.

E. General Testing and Inspection:

1. All sewers will be visually inspected, tested, and gauged for infiltration and/or exfiltration.
2. All visible leaks shall be repaired even if infiltration is within allowable limits.
3. Broken or cracked pipe, mislaid pipe, and other defects shall be corrected.
4. All repairs, re-laying of sewers, etc., required to bring the sewers to specified status shall be made at no additional cost to the Owner.
5. Clean and prepare for inspection each block or section of sewer upon completion, or at such other time as directed by the Architect/Engineer.
6. Each section of pipe between manholes shall show a full circle of light when viewed from either end.
7. All testing is to be performed in the presence of the Architect/Engineer or other Owner Representative. Give at least three (3) day advance notice before performing tests.
8. All expenses for testing shall be borne by the Contractor.
9. In the event that the sewer line does not pass all testing, the Contractor shall make all necessary repairs, by a method approved by the Architect/Engineer, at no additional expense to the Owner.

F. Pressure Test: Test in accordance with SCDHEC and Municipal Authority and the following requirements:

1. When groundwater is less than 4-feet (1.2 m) above the top of the sewer pipe, sewers and appurtenances shall successfully pass an air test prior to acceptance.

a. Plug all wyes, tees, stubs, and service connections with gasket caps of plugs securely fastened or blocked to withstand the internal pressure test. Such plugs or caps shall be removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
b. Furnish all necessary testing equipment and perform the test in a manner satisfactory to the Architect/Engineer. Any arrangement of equipment that will provide observable and accurate measurements of an air leakage under the specified condition with be permitted.
c. Testing of sections of the constructed sanitary sewer, for acceptance, will not be performed until all service connections, manholes, and backfilling, and associated compaction, are completed between the stations to be tested.
d. Air Testing Procedure: After the plugs are in place and securely blocked, introduce air slowly into the pipe section to be tested until the internal air pressure reaches 4.0 psi greater than the average backpressure of any groundwater that may submerge the pipe. Allow a minimum of 2-minutes for the air pressure to stabilize. Determine the height of the groundwater table at the time of the test.

1) The pipe and joints shall be considered satisfactory when the time required, in seconds, for the pressure to decrease from 3.5 psi to 2.5 psi greater than the average backpressure of any groundwater that may submerge the pipe in not less than that computed in accordance with the following formulas:

a) T = (Pipe Diameter) (0.15)

T = Time per 100 feet

2) Conduct Air Tests complying with ASTM C828 or C924.

e. Subsequent Failure: Infiltration of groundwater in an amount greater than specified under Infiltration Testing, following a successful Air Test as specified, shall be considered as evidence that the original test was in error or that subsequent failure of the pipe has occurred.

G. Infiltration Test: Test in accordance with SCDHEC and Municipal Authority and the following requirements:

1. When groundwater is at least 4-feet above the top of the sewer pipe, an infiltration test will be used to determine the integrity of the sewer line.

a. If no leakage is observed, it can be assumed that the line passes the test.
b. If leakage is observed, conduct test using a V-notch sharp crested weir in a wood frame tightly secured to the manhole at the low end of the gravity sewer, or by direct measure, prior to allowing sewage flows in the line.

1) Close the end of the sewer at upstream structures sufficiently to prevent the entrance of water.
2) Discontinue the use of well points or other groundwater pumping operations at least three (3) days prior to testing.
3) Infiltration into the entire system of new sewers, or any one trunk, interceptor or outfall sewer, including connecting laterals, or any stretch of sewer shall not exceed:

a) 200 gal/day/inch of pipe diameter/mile of pipe.

H. Deflection Test: Test in accordance with SCDHEC and Municipal Authority and the following requirements:

1. Perform deflection test on all PVC sewer pipe.
2. No pipe to exceed a deflection of 5-percent.
3. Conduct deflection testing after the final backfill, and compaction thereof, has been in-place at least thirty (30) days and prior to placing the sewer line into operation.
4. Conduct Go/No Go deflection test using a rigid ball or mandrel have a diameter equal to 95-percent of the inside diameter of the pipe.
5. Do not use mechanical pulling devices for the deflection tests.

I. 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 authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. If authorities having jurisdiction do not have published procedures, perform tests as follows:

a. Sanitary Sewerage: Perform hydrostatic test.

1) Allowable leakage is a maximum of 50 gal. per inch of nominal pipe size per mile of pipe, during 24-hour period.
2) Close openings in system and fill with water.
3) Purge air and refill with water.
4) Disconnect water supply.
5) Test and inspect joints for leaks.
6) Option: Test ductile-iron piping according to AWWA C600, Section "Hydrostatic Testing." Use test pressure of at least 10 psig.

b. Sanitary Sewerage: Perform air test according to UNI-B-6.

1) Option: Test concrete piping according to ASTM C 924.

c. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than one and one-half times maximum system operating pressure, but not less than 150 psig.

1) Ductile-Iron Piping: Test according to AWWA C600, Section "Hydraulic Testing."
2) PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

6. Manholes: Perform hydraulic test according to ASTM C 969.
7. Leaks and loss in test pressure constitute defects that must be repaired.
8. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 PROTECTION

A. Protect pipe and bedding cover from damage or displacement until backfilling operation is completed.

END OF SECTION 33 30 00

SECTION 33 41 13 - FOUNDATION DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building perimeter drainage system.
2. Filter aggregate and fabric.
3. Bedding.

1.2 SUBMITTALS

A. Product Data: Manufacturer information on pipe drainage products, pipe accessories, filter aggregate and fabric, and bedding.

B. Shop Drawings: Dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and connections to drainage system.

C. Manufacturer's Certificate: Products meet or exceed specified requirements.

D. Manufacturer Instructions: Installation requirements, including storage and handling procedures.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pipe runs, connections, cleanouts, principal invert elevations, and pipe slopes.

1.4 QUALITY ASSURANCE

A. Perform Work according to SCDOT and local municipality standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials according to manufacturer instructions.

B. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.6 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PIPING

A. Description:

1. Material: PVC, ASTM D2729.
2. Ends: Bell and spigot.
3. Fittings: PVC.
4. Joints:

    a. Rubber gasket.
    b. Comply with ASTM F477.

B. Description:

1. Material: Corrugated plastic tubing.
2. Type: Flexible.
3. End Connections: Coupling bands.

2.2 MATERIALS

A. Filter Aggregate and Bedding, as specified in Section 310516 - Aggregates for Earthwork.

B. Filter Sand and Bedding, as specified in Section 310516 - Aggregates for Earthwork.

C. Impervious Fill: As specified in Section 310513 - Soils for Earthwork.

2.3 ACCESSORIES

A. Pipe Couplings: Solid plastic.

B. Filter Fabric:

1. Type: Water pervious.
2. Material: Black polyolefin or polyester.

C. Pipe Sleeves: Plastic type for foundation wall.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavated base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated.

3.2 PREPARATION

A. Correct over-excavation with aggregate as specified in Section 310516 - Aggregates for Earthwork.

3.3 INSTALLATION

A. Install perforated and unperforated pipe for subdrainage system, and unperforated pipe through sleeved walls.

B. Place drainage piping on clean-cut subsoil and/or compacted impervious fill.

C. Slope:

1. Lay pipe to slope gradients as indicated.
2. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.

D. Place pipe with perforations facing down, and mechanically join pipe ends.

E. Install pipe couplings.

F. Compaction: As specified in Section 312323 - Fill.

G. Cover:

1. Install aggregate at sides, over joint, and over top of pipe.
2. Install top cover to compacted thickness of 8 inches, minimum.

H. Place filter fabric over leveled top surface of aggregate cover prior to subsequent backfilling operations.

I. Place aggregate in maximum 6-inch lifts, consolidating each lift.

J. Place impervious fill over drainage pipe aggregate cover, and compact.

K. Connect to stormwater conveyance system using unperforated pipe.

3.4 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

B. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION 33 41 13

SECTION 33 42 00 - STORMWATER CONVEYANCE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stormwater drainage piping.
2. Manholes.
3. Catch basins.
4. Cleanouts.
5. Bedding and cover materials.

1.2 SUBMITTALS

A. Product Data: Manufacturer information describing pipe, pipe accessories, pre-cast concrete catch basins and manholes and clean-outs.

B. Manufacturer's Certificate: Products meet or exceed specified requirements.

C. Manufacturer Instructions: Special procedures required to install specified products.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, cleanouts, invert elevations, and pipe slopes.

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

1.4 QUALITY ASSURANCE

A. Perform Work according to SCDOT and local municipality standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials according to manufacturer instructions.

B. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.6 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Ductile-Iron Piping:

1. Pipe:

a. Comply with ASTM A746, Class 50.
b. Type: Extra heavy.
c. Ends: Bell and spigot.

2. Fittings: Ductile iron.
3. Joints:

a. Comply with ASTM A746.
b. Joint Devices: Rubber gasket.

B. Reinforced Concrete Piping:

1. Pipe:

a. Comply with ASTM C76, Class III and IV, with Wall Type B.
b. Reinforcement: Mesh.
c. Inside Nominal Diameter: As noted on plans.
d. End Connections: Tongue and groove.

2. Fittings: Reinforced concrete.
3. Joints:

a. Comply with ASTM C443.
b. Gaskets: Rubber, compression and “o” ring.

C. PVC Piping (Roof and channel drain connectors only):

1. Pipe:

a. Comply with ASTM D2680, D3034; SDR 35.
b. Inside Nominal Diameter: As noted on plans.
c. Style: Bell and spigot with rubber-ring sealed gasket joint.

2. Fittings: PVC.
3. Joints:

a. Comply with ASTM F477.

b. Gaskets: Elastomeric.

D. Corrugated PE Piping:

1. Pipe:

a. Comply with ASTM F405, ASTM F667/F667M, AASHTO M252 and AASHTO M294.
b. Type: Perforated and Smooth interior.
c. Inside Nominal Diameter: As noted on plan.

2. Fittings: PE.
3. Joints: Comply with ASTM F405, ASTM F667/F667M, AASHTO M252, and AASHTO M294.

2.2 MANHOLES

A. Manhole Sections:

1. Materials:

a. Reinforced Precast Concrete: Comply with SCDOT standards.
b. Joints: Rubber gasketed. Comply with SCDOT standards.

B. Mortar and Grout:

1. Comply with SCDOT standards.

C. Shaft and Eccentric Cone Top Sections:

1. Pipe Sections: Reinforced precast concrete. Comply with SCDOT standards.
2. Joints:

a. Rubber gasketed. Comply with SCDOT standards.

3. Sleeved to receive pipe and/or conduit sections.

D. Frames and Covers:

1. Materials: Cast iron, heavy duty service.
2. Furnish materials according to SCDOT standards.

2.3 CATCH BASINS

A. Basins:

1. Material: Reinforced precast concrete, heavy traffic, structural loading. Comply with SCDOT standards.
2. Joints: Rubber gasketed. Comply with SCDOT standards.
3. Steps: Comply with SCDOT standards.
4. Pipe Connectors: Comply with SCDOT standards.

B. Grates and Frames:

1. Materials: Cast iron, heavy duty service.
2. Furnish materials according to SCDOT standards.

2.4 CLEANOUTS

A. Shaft and Top Section:

1. Material: PVC pipe sections, riser, and fittings.
2. Joints: Bell and spigot with rubber-ring sealed gasket.

B. Cleanout Lids:

1. Materials: PVC, same material as pipe.
2. Lid: Threaded plug

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Comply with SCDOT standards.
2. Cover: Fill as specified in Section 310516 - Aggregates for Earthwork.
3. Soil Backfill from above Pipe to Finish Grade: Soil Type as specified in Section 310513 - Soils for Earthwork.
4. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.6 MIXES

A. Grout: Comply with SCDOT standards.

2.7 FINISHES

A. Steel Galvanizing:

1. Comply with ASTM A123/A123M.
2. Hot-dip galvanized after fabrication.

B. Galvanizing for Nuts, Bolts, and Washers: Comply with ASTM A153/A153M.

2.8 ACCESSORIES

A. Geotextile Filter Fabric: As specified in Section 310519.13 - Geotextiles for Earthwork.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavation base is ready to receive Work of this Section.

B. Verify that excavations, dimensions, and elevations are as indicated.

3.2 PREPARATION

A. Correct over-excavation with fine aggregate or coarse aggregate as specified in Section 310516 – Aggregates for Earthwork.

B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

A. Excavation and Bedding:

1. Excavate trench as specified in Section 312316 – Excavation and 312316.13 - Trenching.
2. Hand trim excavation for accurate placement of piping to indicated elevations.
3. Maintain optimum moisture content of bedding material to attain required compaction density.
4. Level fill materials in continuous layers not exceeding 8 inches in depth, and compact to 95 percent maximum density.
5. Place geotextile fabric over compacted bedding, if required.

B. Piping:

1. Pipe, Fittings, and Accessories: Comply with ASTM D2321.
2. Seal joints watertight.
3. Place pipe on minimum 4-inch-deep bed of No.57 filter aggregate.
4. Cradle bottom 20 percent of pipe diameter to avoid point load.
5. Install aggregate at sides and over top of pipe.
6. Install top cover to minimum compacted thickness of 12 inches, and compact to 95 percent maximum density.
7. Backfilling and Compaction: As specified in Section 312323 - Fill.
8. Connect to municipal storm sewer system.
9. Connect to subdrainage tile system piping as specified in Section 334113 - Foundation Drainage.
10. Install Site storm drainage system piping to within 5 feet of building or as shown in plans.
11. Connect building roof drain and foundation drain systems as specified in Section 334113 – Foundation Drainage.

C. Catch Basins and Cleanouts:

1. Form bottom of excavation clean and smooth, and to indicated elevation.
2. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.
3. Level top surface of base pad.

4. Sleeve concrete shaft sections to receive storm sewer pipe sections.
5. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
6. Mount lid and frame level in grout, secured to top section to indicated elevation.

D. Precast Concrete Manholes:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:

    a. Assemble multi-section manholes and structures by lowering each section into excavation.
    b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
    c. Lower, set level, and firmly position base section before placing additional sections.

4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Verify that installed manholes and structures meet required alignment and grade.
8. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
9. Cut pipe flush with interior of structure.
10. Shape inverts through manhole and structures as indicated.
11. Set frames using mortar and masonry to indicated elevation.

3.4 TOLERANCES

A. Maximum Variation from Indicated Pipe Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

A. Inspection:

1. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

B. Testing:

1. Do not enclose, cover, or put into service before inspection and approval.
2. Compaction Test:

    a. Comply with ASTM D1557, ASTM D698, and/or ASTM D6938 as applicable.
    b. Testing Frequency: In accordance with authorities having jurisdiction.

3. Piping Systems:

    a. In accordance with authorities having jurisdiction.
    b. Schedule tests and inspections by authorities having jurisdiction with at least 24 hour’s advanced notice.

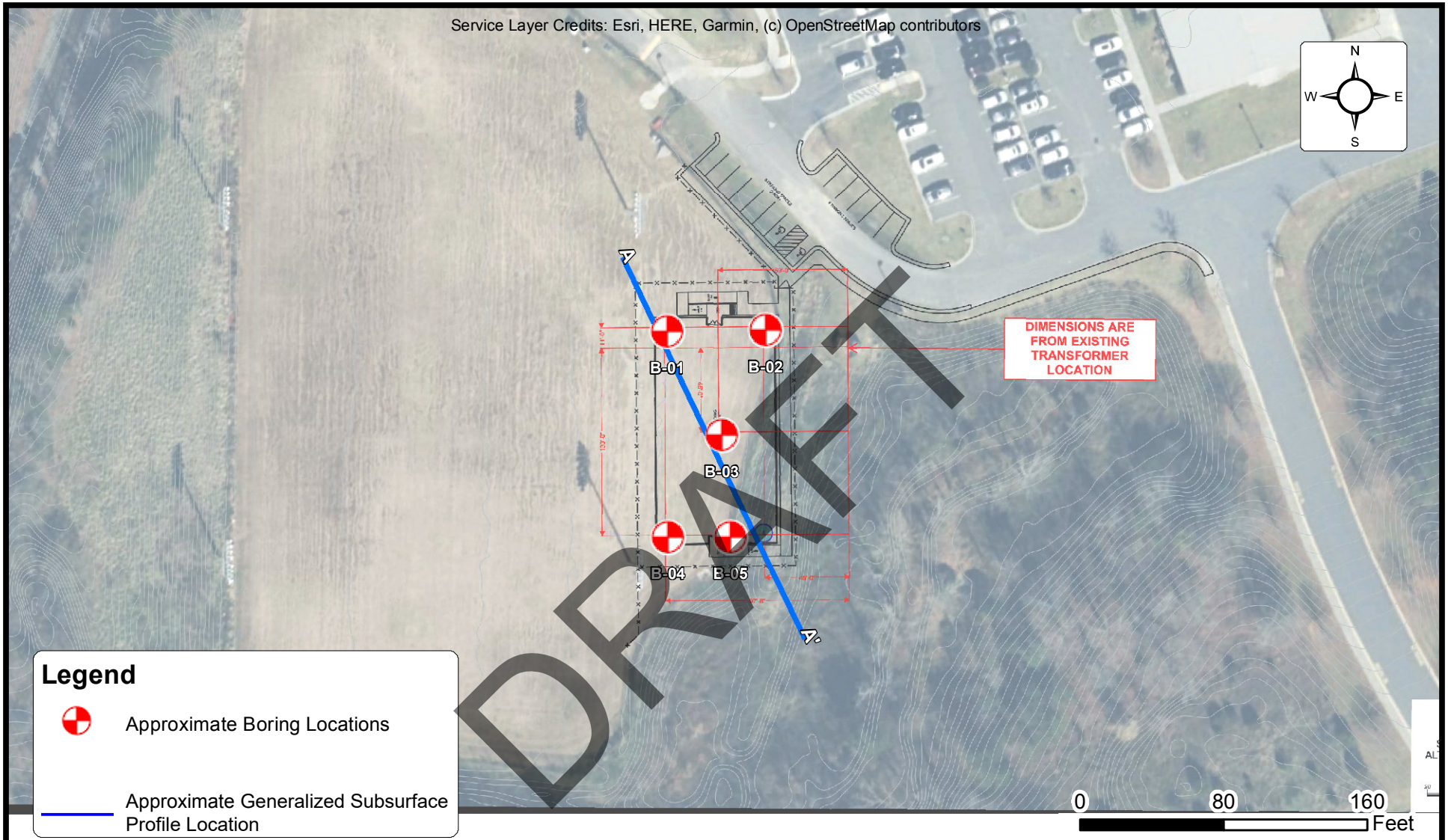
4. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

3.6 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 33 42 00

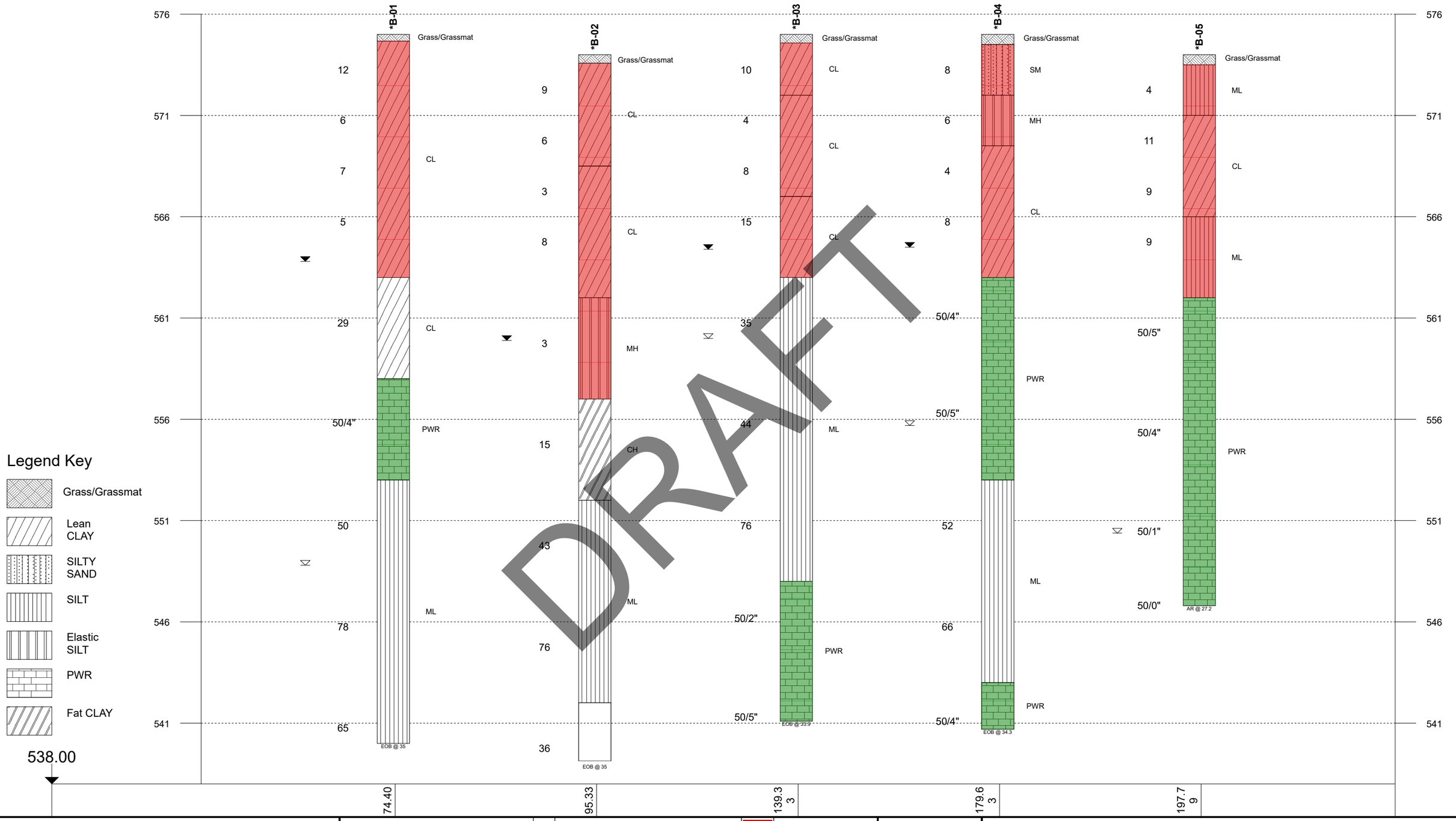
ATTACHMENT A – SOIL BORING LOCATION DIAGRAM



BORING LOCATION DIAGRAM
FMSD ALTERNATIVE SCHOOL

A O JONES BLVD, FORT MILL, SOUTH CAROLINA
FORT MILL SCHOOL DISTRICT

ENGINEER	CJC
SCALE	AS NOTED
PROJECT NO.	08:15510
FIGURE	2
DATE	4/11/2023



Notes:

1- EOB: END OF BORING AR: AUGER REFUSAL SR: SAMPLER REFUSAL.
2- THE NUMBER BELOW THE STRIPS IS THE DISTANCE ALONG THE BASELINE.
3- SEE INDIVIDUAL BORING LOG AND GEOTECHNICAL INFORMATION.
4- STANDARD PENETRATION TEST RESISTANCE (LEFT OF BORING) IN BLOWS PER FOOT (ASTM D1586).

Plastic Limit Water Content Liquid Limit X——●——△	WL (First Encountered)		Fill
[FINES CONTENT %]	WL (Completion)		Possible Fill
BOTTOM OF CASING	WL (Estimated Seasonal High Water)		Probable Fill
100% LOSS OF CIRCULATION	WL (Stabilized)		Rock

GENERALIZED SUBSURFACE SOIL PROFILE A-A'

FMSD Alternative School - GEO
Fort Mill School District
A O Jones Blvd, Fort Mill, South Carolina, 29715

Project No: 08:15510 Date: 04/11/2023

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-01**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170223.4	**2024319.2**		**575**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Grass/Grassmat Thickness[4"]		
	S-1	SS	18	18	(CL FILL) LEAN CLAY, contains roots and organic laden soil, dark brown to gray, moist		4-6-6 (12)
	S-2	SS	18	18			3-3-3 (6)
5						570	
	S-3	SS	18	18			2-4-3 (7)
	S-4	SS	18	18			2-2-3 (5)
10						565	
					(CL) Residuum, LEAN CLAY, orangish brown and gray, moist, very stiff		
	S-5	SS	18	18			8-12-17 (29)
15						560	
					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY SILT, orangish brown		
	S-6	SS	16	16			21-46-50/4" (96/10")
20						555	
					(ML) SANDY SILT, orangish brown, moist, hard to very hard		
	S-7	SS	18	18			20-23-27 (50)
25						550	
	S-8	SS	18	18			22-36-42 (78)
30						545	

CONTINUED ON NEXT PAGE

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **26.10**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **24.20**	
WL (Completion) **11.10**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-01**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170223.4	**2024319.2**		**575**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT (20 40 60 80 100) / ROCK QUALITY DESIGNATION & RECOVERY (RQD, REC)	LIQUID LIMIT / PLASTIC LIMIT / CALIBRATED PENETROMETER TSF (1 2 3 4 5) / WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)
					(ML) SANDY SILT, orangish brown, moist, hard to very hard					
35	S-9	SS	18	18			540	20-25-40 (65)	65	
					END OF BORING AT 35 FT					
40							535			
45							530			
50							525			
55							520			
60							515			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **26.10**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **24.20**	
WL (Completion) **11.10**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-02**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170224.1	**2024373.8**		**574**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					Grass/Grassmat Thickness[5"]			
	S-1	SS	18	18	(CL FILL) SANDY LEAN CLAY, contains roots and organic laden soil, reddish brown, moist			3-4-5 (9)
	S-2	SS	18	18				2-3-3 (6)
5	S-3	SS	18	18	(CL FILL) SANDY LEAN CLAY, contains roots and organic laden soil, reddish brown to gray, moist		569	2-2-1 (3)
	S-4	SS	18	18				5-4-4 (8)
10					(MH FILL) ELASTIC SILT, contains roots and organic laden soil, gray, wet		564	
	S-5	SS	18	18		▼		3-2-1 (3)
15					(CH) Residuum, SANDY FAT CLAY, brownish gray, wet, soft		559	
	S-6	SS	18	18				6-7-8 (15)
20					(ML) SANDY SILT, dark gray, moist, hard to very hard		554	
	S-7	SS	18	18				8-16-27 (43)
25							549	
	S-8	SS	18	18				24-32-44 (76)
30							544	

CONTINUED ON NEXT PAGE

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY — RQD — REC
LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **GNE**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **33.00**	
WL (Completion) **14.00**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-02**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170224.1	**2024373.8**		**574**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	STANDARD PENETRATION BLOWS/FT (20 40 60 80 100) / ROCK QUALITY DESIGNATION & RECOVERY (RQD, REC)	LIQUID LIMIT / PLASTIC LIMIT / CALIBRATED PENETROMETER TSF (1 2 3 4 5) / WATER CONTENT % [FINES CONTENT] % (10 20 30 40 50)
					(ML) SANDY SILT, dark gray, moist, hard to very hard					
35	S-9	SS	18	0	(NO RECOVERY)		539	14-18-18 (36)	36	
					END OF BORING AT 35 FT					
40							534			
45							529			
50							524			
55							519			
60							514			

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **GNE**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **33.00**	
WL (Completion) **14.00**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-03**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170165.7	**2024349.4**		**575**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Grass/Grassmat Thickness[5"]		
	S-1	SS	18	18	(CL FILL) LEAN CLAY, contains roots and organic laden soil, reddish brown, moist		3-4-6 (10)
	S-2	SS	18	18	(CL FILL) SANDY LEAN CLAY, contains roots and organic laden soil, brown, moist	570	2-2-2 (4)
5	S-3	SS	18	18			2-2-6 (8)
	S-4	SS	18	18	(CL FILL) SANDY LEAN CLAY, contains roots and organic laden soil, gray, moist	565	3-5-10 (15)
10					(ML) Residuum, SANDY SILT, orangish brown, moist, hard to very hard		
	S-5	SS	18	18		560	17-18-17 (35)
15							
	S-6	SS	18	18		555	16-18-26 (44)
20							
	S-7	SS	18	18		550	17-36-40 (76)
25							
	S-8	SS	8	8	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY LEAN CLAY, orangish brown	545	43-50/2" (50/2")
30							

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

CONTINUED ON NEXT PAGE

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **14.90**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **25.50**	
WL (Completion) **10.50**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-03**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170165.7	**2024349.4**		**575**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
35	S-9	SS	5	5	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY LEAN CLAY, orangish brown		540	50/5" (50/5")
					END OF BORING AT 33.9 FT			
40							535	
45							530	
50							525	
55							520	
60							515	

STANDARD PENETRATION BLOWS/FT: 20 40 60 80 100 — 50/5"

ROCK QUALITY DESIGNATION & RECOVERY: RQD, REC

LIQUID LIMIT / PLASTIC LIMIT

CALIBRATED PENETROMETER TSF: 1 2 3 4 5

WATER CONTENT % [FINES CONTENT] %: 10 20 30 40 50

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**14.90**	BORING STARTED:	**Apr 05 2023**	CAVE IN DEPTH:	**25.50**
WL (Completion)	**10.50**	BORING COMPLETED:	**Apr 05 2023**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT:	LOGGED BY:	DRILLING METHOD:	**HSA 2.25**
WL (Stabilized)		**ATV CME 550x**	**TJL3**		

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-04**	**1 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170108.9	**2024319.4**		**575**

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ELEVATION (FT)	BLOWS/6"
					Grass/Grassmat Thickness[6"]		
	S-1	SS	18	18	(SM FILL) SILTY SAND, grayish brown, moist		8-5-3 (8)
	S-2	SS	18	18	(MH FILL) SANDY ELASTIC SILT, contains roots and organic laden soil, grayish brown, moist		3-3-3 (6)
5						570	
	S-3	SS	18	18	(CL FILL) LEAN CLAY, contains roots and organic laden soil, grayish brown, moist		2-2-2 (4)
	S-4	SS	18	18			4-3-5 (8)
10						565	
	S-5	SS	10	10	(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY SILT, grayish brown		42-50/4" (50/4")
15						560	
	S-6	SS	5	5			50/5" (50/5")
20						555	
					(ML) SANDY SILT, reddish brown to dark brown, moist, very hard		
	S-7	SS	18	18			14-20-32 (52)
25						550	
	S-8	SS	18	18			21-27-39 (66)
30						545	

CONTINUED ON NEXT PAGE

STANDARD PENETRATION BLOWS/FT (20 40 60 80 100)
ROCK QUALITY DESIGNATION & RECOVERY — RQD — REC
LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF (1 2 3 4 5)
WATER CONTENT %
[FINES CONTENT] % (10 20 30 40 50)

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered) **19.20**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **25.60**	
WL (Completion) **10.40**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**	
WL (Seasonal High Water)	EQUIPMENT: **ATV CME 550x**	LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-04**	**2 of 2**
PROJECT NAME:	DRILLER/CONTRACTOR:		
FMSD Alternative School - GEO	**Wells Geotech LLC**		
SITE LOCATION:			LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715			
NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:
1170108.9	**2024319.4**		**575**

BOTTOM OF CASING

DEPTH (FT)	SAMPLE NUMBER	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(ML) SANDY SILT, reddish brown to dark brown, moist, very hard			
					(PWR) PARTIALLY WEATHERED ROCK SAMPLED AS SANDY SILT, dark brown			
	S-9	SS	10	10				41-50/4" (50/4")
35					**END OF BORING AT 34.3 FT**		540	
40							535	
45							530	
50							525	
55							520	
60							515	

STANDARD PENETRATION BLOWS/FT
20 40 60 80 100
ROCK QUALITY DESIGNATION & RECOVERY
RQD
REC
50/4"

LIQUID LIMIT
PLASTIC LIMIT
CALIBRATED PENETROMETER TSF
1 2 3 4 5
WATER CONTENT %
[FINES CONTENT] %
10 20 30 40 50

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

WL (First Encountered)	**19.20**	BORING STARTED:	**Apr 05 2023**	CAVE IN DEPTH:	**25.60**
WL (Completion)	**10.40**	BORING COMPLETED:	**Apr 05 2023**	HAMMER TYPE:	**Auto**
WL (Seasonal High Water)		EQUIPMENT:	LOGGED BY:	DRILLING METHOD:	**HSA 2.25**
WL (Stabilized)		**ATV CME 550x**	**TJL3**		

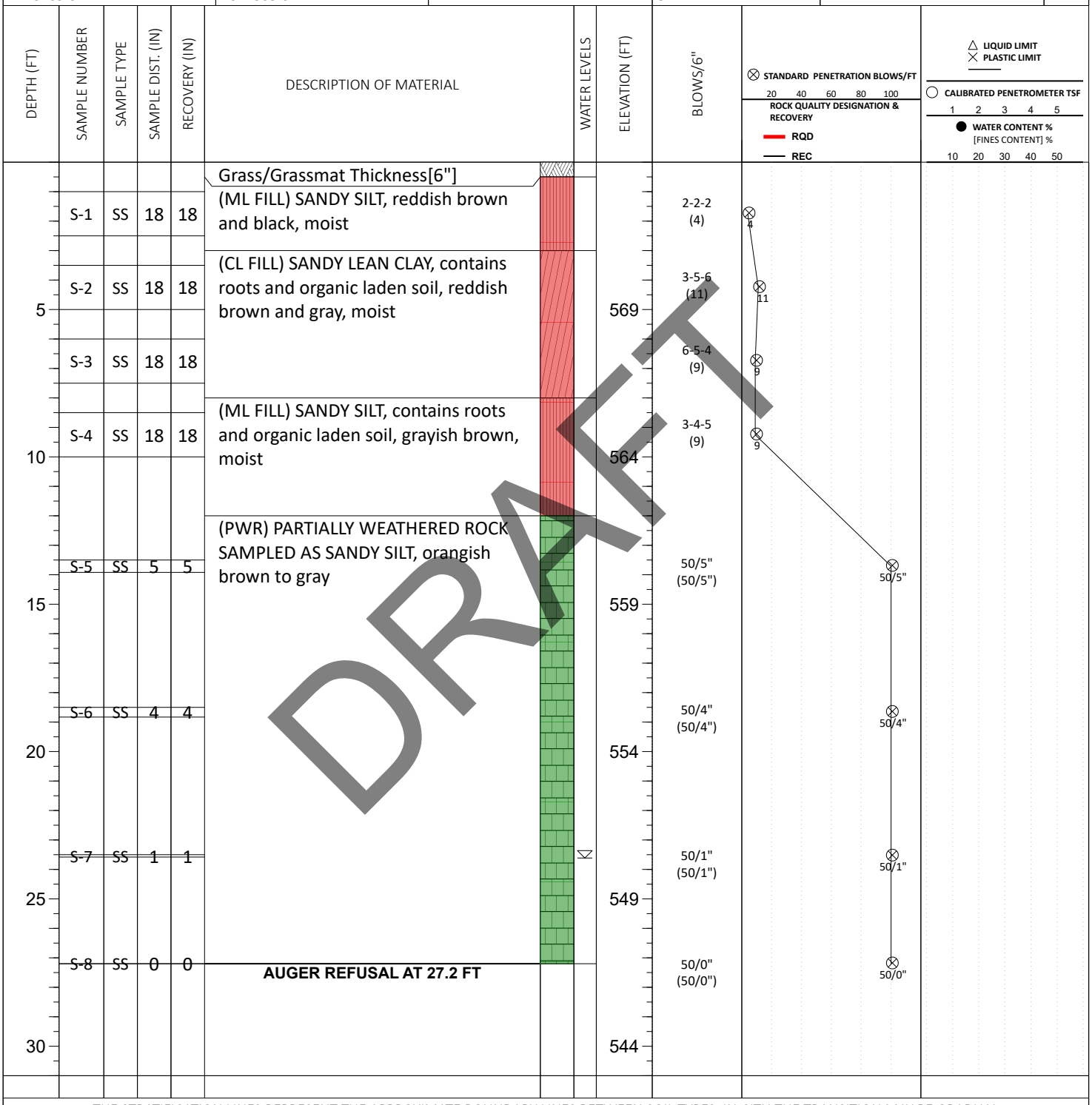
GEOTECHNICAL BOREHOLE LOG

CLIENT:	PROJECT NO.:	BORING NO.:	SHEET:
Fort Mill School District	**08:15510**	**B-05**	**1 of 1**

PROJECT NAME:	DRILLER/CONTRACTOR:
FMSD Alternative School - GEO	**Wells Geotech LLC**

SITE LOCATION:	LOSS OF CIRCULATION
A O Jones Blvd, Fort Mill, South Carolina, 29715	

NORTHING:	EASTING:	STATION:	SURFACE ELEVATION:	BOTTOM OF CASING
1170109.0	**2024365.6**		**574**	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL

▽ WL (First Encountered)	**23.50**	BORING STARTED: **Apr 05 2023**	CAVE IN DEPTH: **25.20**
▼ WL (Completion)	**GNE**	BORING COMPLETED: **Apr 05 2023**	HAMMER TYPE: **Auto**
⧩ WL (Seasonal High Water)		EQUIPMENT: **ATV CME 550x** / LOGGED BY: **TJL3**	DRILLING METHOD: **HSA 2.25**
⧩ WL (Stabilized)			

GEOTECHNICAL BOREHOLE LOG

ATTACHMENT B – STATEMENT OF SPECIAL INSPECTIONS

Statement of Special Inspections

Project: Fort Mill Sugar Creek ES Portable Permit Number: _____

Project Location: _____

Owner/Address: _____ City _____ Zip _____

Registered Design Professional
In Responsible Charge: Jeffrey M. Dillon

Address: 1226 Yeamans Hall Rd

City: Hanahan State: SC Zip: 29410 Phone: 843-566-0161

E-mail: markd@adcengineering.com

This statement of Special Inspections attached is submitted as a condition for permit issuance in accordance with Section 1704 of the 2021 International Building Code. It includes a Schedule of Special Inspection Services applicable to the above referenced project as well as the identity of the individuals, agencies, or firms (completed by others) intended to be retained for conducting these inspections. The Special Inspection Coordinator (Registered Design Professional In Charge of Administering Special Inspections) shall keep records of all inspections and shall furnish interim inspection reports to the Engineer of Record (Registered Design Professional in Responsible Charge of Construction Documents) at a frequency agreed upon by the permit applicant and Building Official prior to the start of work. Discrepancies shall be brought to the immediate attention of the Contractor and the Engineer of Record for correction. If the discrepancies are not corrected, the Special Inspection Coordinator shall bring the discrepancies to the attention of the Building Official and the Engineer of Record prior to the completion of that phase of work. The Special Inspection Coordinator shall submit a Final Report of Special Inspections to the building official at the conclusion of the project and before a certificate of occupancy will be issued.

Statement of Special Inspections encompass the following disciplines:

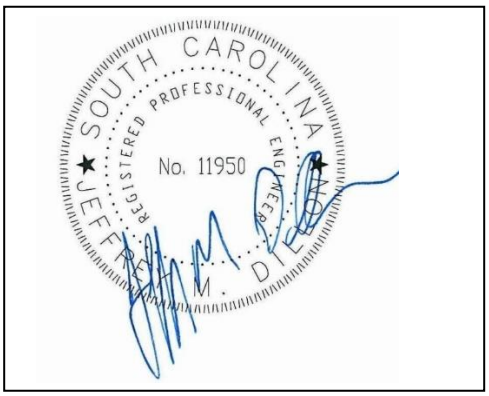
☒ Structural ☐ Mechanical/Electrical/Plumbing
☐ Architectural ☐ Other: _____

Prepared by:

Jeffrey M. Dillon
Type or Print Name

Signature

May 10, 2023
Date



Preparer's Seal and Signature Required

To be filled out by the jurisdiction and returned to applicant
Building Official's Acceptance of Special Inspections ☐ ☐

Frequency of Interim reports: Monthly Bi-Monthly ☐ Upon Completion ☐ Per Attached Schedule

Signature Date TMS Permit Number

Schedule of Inspection and Testing Agencies

This Statement of Special Inspections includes the following building systems:

- ☒ Soils and Foundations
- ☒ Cast-in-Place Concrete
- ☐ Precast Concrete
- ☒ Masonry
- ☐ Structural Steel
- ☐ Cold-Formed Steel Framing
- ☐ Wood Construction
- ☐ Architectural Components
- ☐ Mechanical & Electrical Systems
- ☐ Storage Racks
- ☐ Spray Fire Resistant Material
- ☐ Special Cases

Special Inspection Agencies	**Firm**	**Address, Telephone, e-mail**
1. **Special Inspection Coordinator (Registered Professional in Responsible Charge of Administering Special Inspections)**		
2. Inspector		
3. Inspector		
4. Testing Agency		
5. Testing Agency		
6. Other		

Note: The inspectors and testing agencies shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the Building Official, prior to commencing work.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official and shall be in accordance with the building code or any particular requirements of the specifications or material specific referenced standards. The credentials of all Inspectors and testing technicians shall be provided if requested.

Special Inspection Definitions

Continuous Special Inspection - Special inspection by the special inspector who is present when and where the work to be inspected is being performed.

Periodic Special Inspection - Special inspection by the special inspector who is intermittently present where the work to be inspected has been or is being performed. Unless noted otherwise 100% of the work designated for inspection shall be inspected.

MATERIAL / ACTIVITY	SCOPE OF SERVICE
1705.1.1 Special Cases	
Post Installed Anchors	
Installer Qualifications	**Review** installer training records to confirm they have received manufacturer training per the contract documents
Anchor Installation	**Continuously** inspect complete process of anchor installation in accordance with requirements of approved ICC ESR report. As minimum review installation procedures including drill bit type, drilling methods, hole preparation and cleaning, spacing, edge distance, embedment depth, adhesive installation, rod installation, curing time, and anchor torque to ensure compliance with manufacturer's instructions and construction documents. (**All anchor holes must be inspected during drilling, all anchor holes must be inspected prior to anchor installation, all anchors shall be inspected at final application of required torque)**

MATERIAL / ACTIVITY	SCOPE OF SERVICE
1705.3 Concrete Construction	
Inspection of reinforcing steel, including prestressing tendons, and placement	**Periodically** inspect reinforcing steel placement in accordance with contract documents and approved shop drawings to confirm size, spacing, cover, positioning, bends, grade, laps, supports and anchorage. **(100% inspection rate immediately prior to placing concrete)**
Inspection of anchors cast in concrete	**Periodically** inspect size, positioning, embedment, and projection of anchor rods is in accordance with contract documents and approved shop drawings. **(100% inspection rate immediately prior to placing concrete)** **Continuously** inspect concrete placement and consolidation around anchors. **(100% inspection rate during concrete placement)**
Inspection of anchors post-installed in hardened concrete members.	**Review** installer training records to confirm they have received manufacturer training per the contract documents **Continuously** inspect complete process of anchor installation in accordance with requirements of approved ICC ESR report. As minimum review installation procedures including drill bit type, drilling methods, hole preparation and cleaning, spacing, edge distance, embedment depth, adhesive installation, rod installation, curing time, and anchor torque to ensure compliance with manufacturer's instructions and construction documents. (**All anchor holes must be inspected during drilling, all anchor holes must be inspected prior to anchor installation, all anchors shall be inspected at final application of required torque)**
Verifying use of required design mix	**Periodically** review batch tickets to confirm the appropriate approved mix design is being used for the location in which concrete is being placed **(100% review rate during concrete placement)** **Periodically** verify that water added at the site does not exceed that allowed by the batch ticket **(100% inspection rate during concrete placement)**

1705.3 Concrete Construction (Continued)	
Sample fresh concrete to fabricate specimens for strength tests, perform fresh unit weight density, slump and air content tests, and determine the temperature of concrete	**Continuously** test concrete compressive strength (ASTM C31 & C39), fresh unit weight density (ASTM C138), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064). Samples for preparing unit weight density specimens and measuring air content shall be obtained at the point of placement. Slump measurements are for reference only and shall not be a basis of rejection. Threshold for fresh unit weight density shall be in accordance with approved mix design submittals (**Frequency of sampling and testing as required by section 21.16 of ACI 318)**
Inspection of concrete for proper application techniques	**Continuously** inspect concrete placement techniques to confirm compliance with section 26.5 of ACI 318.
Inspection for maintenance of specified curing temperatures and techniques	**Periodically** inspection curing temperatures and techniques to insure compliance with contract documents and sections 26.5.3, 26.5.4 and 26.5.5 of ACI 318-14
Inspection of formwork for shape, location and dimensions of concrete member being formed	**Periodically** inspect formwork to ensure compliance with dimensions of members indicated on contract documents **(100% inspection rate during concrete placement)**

MATERIAL / ACTIVITY	SCOPE OF SERVICE
1705.4 Masonry Construction	
Verify compliance with approved submittals	**Periodically** review batch tickets to confirm the appropriate approved grout mix design is being used. **(100% review rate during grout placement)** **Periodically** review mortar materials to confirm compliance with approved submittals. **(A minimum of once weekly during masonry construction)**
Verify proportions of site prepared mortar	**Periodically** inspect proportioning, mixing and re-tempering of mortar. **(A minimum of once daily during masonry construction)**
Inspect construction of mortar joints	**Periodically** inspect construction of mortar joints including tooling and filling of head joints. **(100% inspection rate a minimum of once daily during masonry construction)**
Inspect location of reinforcement and connectors	**Periodically** inspect placement, positioning and lapping of reinforcing steel **(100% inspection rate a minimum of once daily during masonry construction)** **Periodically** inspect size, grade and type of reinforcing. **(100% inspection rate a minimum of once daily during masonry construction)** **Continuously** inspect placement positioning and lapping of joint reinforcement. **(100% Inspection rate – inspector shall be in the area of masonry work to monitor installation)** **Periodically** inspect size, grade, type and location of anchor rods and embeds. **(100% inspection rate a minimum of once daily during masonry construction)**
Inspect Grout Space	**Periodically** grout spaces to ensure minimum clear grout spaces are achieved, and that grout spaces are free from debris, mortar fins and mortar droppings. Confirm mortar fins and mortar droppings are being manually removed as masonry is constructed. **(100% inspection rate a minimum of once daily during masonry construction)**
Verify proportions of site prepared grout	**Periodically** inspect proportioning, mixing and re-tempering of mortar. **(A minimum of once daily during masonry construction)**
Proportions of site prepared grout	**Continuously** inspect proportioning and mixing of site batched grout. Confirm acceptable measurement devices are being employed and that the mix proportions are in accordance with approved submittals.
Verify size and location of structural masonry elements	**Periodically** inspect the size and location of structural elements to comply with contract drawings. **(100% inspection rate a minimum of once daily during applicable portion of the work)**

MATERIAL / ACTIVITY	SCOPE OF SERVICE
1705.4 Masonry Construction (Continued)	
Verify protection of masonry during hot/cold weather	**Periodically** inspect protection of masonry during cold weather (temperature below 40 deg F) or hot weather (temperature above 90 deg F) **Periodically** verify that all wall cavities are protected against precipitation. **(100% inspection rate a minimum of once daily during applicable portion of the work)**
Verify grout placement complies with code and construction document provisions	**Continuously** inspect placement, consolidation and reconsolidation of grout. **(100% inspection rate)** **Continuously** verify grouting and grout consolidation procedures are in accordance with code and contract document provisions. **(100% inspection rate)**
Evaluation of grout Strength	**Continuously** Test compressive strength of grout samples (ASTM C1019). (**Sample and test grout for every 5000 sq ft. of wall, but not less than one set of samples for each day's worth of grouting)**

MATERIAL / ACTIVITY	SCOPE OF SERVICE
1705.9 Helical Pile Foundations	
Inspect production pile installation operations and maintain complete and accurate records for each element	**Continuously** inspect contractors initial layout of piles and **Periodically** inspect final location of piles (by review of contractor as built) to ensure location is within specified tolerance **(100% inspection rate of all piles)** **Continuously** plumbness of piles at various stages during the installation of each individual pile. Confirm plumbness of pile is within specified tolerance as close to the end of installation of the individual pile as practically possible. **(100% inspection rate of all piles)** **Continuously** inspect and log type and size of equipment used, pile dimensions, tip elevations, final depth, final installation torque to verify compliance with construction documents and approved shop drawing submittals **(100% inspection rate of all piles)**

ATTACHMENT C – YORK COUNTY SOUTH CAROLINA WATER AND SEWER TECHNICAL SPECIFICATIONS, JUNE 2021

WATER AND SEWER

Technical Specifications

June, 2021

These technical specifications include references to construction, testing and materials standards of various organizations. Note that all references, herein, apply unless they are superseded by any relevant or applicable requirements of SCDOT, SCDHEC, York County or any other Authorities having jurisdiction where the work is taking place.

dhec

DRINKING WATER AND RECREATIONAL WATER PROTECTION
WATER AND SEWER CONSTRUCTION ONLY
(Subject to any provisions which may appear in the construction permit)

Final written approval for operation must be obtained from DHEC after completion of construction.

Approved for:

Water Permit SS-000106
Wastewater Permit SS-02164
Date 6/08/2021
Reviewer Maia Milenkova

TABLE OF CONTENTS

SPECIFICATIONS

* Denotes Pump Station Standard Specifications.
SC DHEC requires the submission of a separate set of project specific Pump Station Specifications for each project. Division 43 represent York County's Specifications for Sewer Pump Stations but they are not part of the overall SC DHEC approved Specifications.

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified and required for demolition, removal, and disposal Work.
   2. The Work under this Section includes, but is not necessarily limited to:
      a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of piping, paving, curbs, sidewalks, gutters, fencing and similar existing facilities.
      b. For pump station Work, this may also include demolition of structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, electrical and mechanical systems and equipment, demolition and removal of all Underground Facilities underneath, and above-grade piping and utilities in, the building(s) and structures shown or indicated for demolition, unless the Underground Facilities or above-grade facilities are shown or indicated as to remain.
   3. Demolitions and removals specified under other Sections shall comply with requirements of this Section.
   4. Perform demolition Work within areas shown or indicated.
   5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition.

B. Coordination:
   1. Comply with Section 01 14 16, Coordination with Owner's Operations.
   2. Review procedures under this and other Sections and coordinate the Work that will be performed with or before demolition and removals.

C. Related Sections:
   1. Section 01 73 29, Cutting and Patching.
   2. Section 31 11 00, Clearing and Grubbing.
   3. Section 31 23 16.26, Rock Removal.

1.2 QUALITY ASSURANCE

A. Qualifications:
   1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
   2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

B. Regulatory Requirements:

1. Demolition, removal, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T - Demolition), and all other Laws and Regulations.
2. Comply with requirements of authorities having jurisdiction.

1.3 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
         1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
         2) Other proposed procedures as applicable.
         3) Equipment proposed for use in demolition operations.
         4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
         5) Planned demolition operating sequences.
         6) Detailed schedule of demolition Work in accordance with the accepted Process Schedule.
   2. Qualifications Statements:
      a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
      b. Name and qualifications of entity performing plumbing removals, including copy of licenses required by authorities having jurisdiction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

A. Protection of Surrounding Areas and Facilities:
   1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties.
   2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
   3. Provide temporary barriers, lighting, sidewalk sheds, and other necessary protection.
   4. Repair damage to facilities that are to remain.

B. Existing Utilities: In addition to requirements of the General Conditions and Division 01 Specifications, do the following:

1. Should uncharted or incorrectly charted Underground Facilities be encountered, CONTRACTOR responsibilities shall be in accordance with the General Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
2. Sanitary Sewer: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
3. Storm Water: Existing storm water system shall remain in place until demolitions of existing building or structure is completed. Upon completing demolition, cut and cap storm sewer laterals at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities.
4. Water Piping: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished.
5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
6. Shutdown of utility services shall be coordinated by CONTRACTOR, assisted by OWNER as required relative to contacting utility owners.

C. Remediation:
1. Prior to performing demolition Work that disturbs Asbestos, remove and dispose of Asbestos in accordance with Section 01 74 19, Construction and Demolition Waste Management.
2. Prior to performing demolition Work involving lead-based paint, remediate lead in accordance with Section 01 74 19, Construction and Demolition Waste Management.

3.2 DEMOLITION – GENERAL

A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on adjacent facilities, and Underground Facilities.

B. Pollution Controls:
1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 57 19, Temporary Environmental Controls, and Laws and Regulations.
2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions.

C. Comply with Section 01 73 29, Cutting and Patching.

D. Building or Structure Demolition:
1. Unless otherwise approved by ENGINEER, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
2. Demolish concrete and masonry in small sections.
3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.

4. Break up and remove foundations and slabs-on-grade unless otherwise shown or indicated as remaining in place.

E. Demolition of Site Improvements:
   1. Pavement, Sidewalks, Curbs, and Gutters: Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
   2. Fencing, Guardrails, and Bollards: Remove to the limits shown or indicated on the Drawings. Completely remove below-grade posts and concrete.
   3. Manholes, Vaults, Chambers, and Handholes: Remove to the limits shown or indicated on the Drawings and in accordance with Part 3 of this Section.
   4. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes: Remove to the extent shown or indicated on the Drawings. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the "Mechanical Removals" Article in this Section.
   5. Landscaping: Comply with Section 31 11 00, Clearing and Grubbing.

F. Salvage and Ownership:
   1. Refer to Section 01 11 13, Summary of Work, for requirements on salvage, ownership, and handling of equipment and materials removed during demolition and removal Work.
   2. Materials and equipment to remain OWNER's property shall be carefully removed and appropriately handled by CONTRACTOR to avoid damage and invalidation of warranties in effect, and shall be cleaned and stored at the Site (or other site specified in the Contract Documents) at place designated by ENGINEER or OWNER.

G. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by ENGINEER.

3.3 ABANDONMENT OF EXISTING MANHOLES

A. Plug both influent and effluent lines inside the manhole with watertight masonry.

B. Fill manhole with non-compressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade.

C. Remove remainder of manhole.

D. Fill excavation to finish grade with suitable soil compact in place.

3.4 ABANDONMENT OF MAINS AT MANHOLES WHICH REMAIN IN SERVICE

A. Completely disconnect main to be abandoned from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry.

B. Rebuild the invert to conform with the standard details.

3.5 ABANDONMENT OF EXPOSED PIPE

A. Remove exposed sections of abandoned mains to a point not less than 5 feet into the adjacent banks.

B. Plug the remaining ends of the pipe with watertight masonry.

C. Remove completely concrete piers and collars in the creek channel.

D. Remove concrete piers, steel piers and collars not located in the creek channel to a point three feet (3'-0") below the finish grade.

3.6 ABANDONMENT OF EXISTING PUMP STATIONS

A. Salvage and transport pumps, motors, controls, etc. to the sewer maintenance yard in New Heritage.

B. Plug all influent and effluent pipes with watertight masonry.

C. Fill the pipe chamber and wetwell (if abandoned) with noncompressible material (#67 stone or as approved), to a point three feet (3'-0") below the finish grade.

D. Remove the remainder of the structure and fill the excavation to finish grade with suitable soil compacted in place.

E. Remove all above ground structures associated with the pump station, including fencing and the access road, and restore the area.

3.7 STRUCTURAL REMOVALS

A. Remove structures to lines and grades shown or indicated, unless otherwise directed by ENGINEER. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at CONTRACTOR's expense and such excess removals shall be reconstructed to satisfaction of ENGINEER without additional cost to OWNER.

B. Recycling and Reuse of Demolition Materials:
   1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by ENGINEER.
   2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.

C. After removing concrete and masonry walls or portions thereof, slabs, and similar construction that ties into the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.

D. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, remove the anchors to not less than 1.5 inches beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface. Alternately, when the anchor is stainless

steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by ENGINEER.

E. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Section, unless specified elsewhere in the Contract Documents.

3.8 MECHANICAL REMOVALS

A. Mechanical demolition and removal Work includes dismantling and removing existing piping, ductwork, pumps, equipment, tanks, and appurtenances as shown, indicated, and required for completion of the Work. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 14 16, Coordination with Owner's Operations; Section 01 73 29, Cutting and Patching; and applicable Sections of Division 40, Process Integration.

B. Demolition and Removals of Piping, Ductwork, and Similar Items:
   1. Purge piping and tanks (as applicable) of chemicals or fuel (as applicable) and make safe for removal and capping. Remove to the extent shown or indicated existing process, water, waste and vent, chemical, gas, fuel, and other piping. Remove piping to the nearest solid piping support, and provide caps on ends of remaining piping. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
   2. Caps, Closures, Blind Flanges, and Plugs:
      a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
      b. Where used in this Section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
      c. Caps shall be compatible with the piping or ductwork to which the cap is attached, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
      d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this Section only when so shown or indicated in the Contractor Documents or when allowed by ENGINEER.
   3. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
   4. Remove waste and vent piping, and ductwork to extent shown and cap as required. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
   5. Modifications to potable water piping and other plumbing and heating system work shall comply with Laws and Regulations. All portions of potable water system that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally-pressurized, plumbing piping and heating piping.

C. Equipment Demolition and Removals:

1. To the extent shown or indicated, remove existing process equipment; pumps; storage tanks; hoisting and conveying equipment; heating, ventilating, and air conditioning equipment; generators; and other equipment.
2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
4. Remove fuel appurtenances as applicable, including fuel storage tanks. Dispose of tank contents in accordance with Laws and Regulations.
5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the “Structural Removals” Article in this Section. Remove small-diameter piping back to header unless otherwise indicated.
6. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.
7. Equipment Salvage: The following entities may be interested in salvaging equipment to be removed under the Contract:
    a. Project Development Services, The Woodlands, Texas.

3.9 ELECTRICAL REMOVALS

A. Electrical demolition Work includes removing existing transformers, distribution switchboards, control panels, motors, starters, conduit and raceways, cabling, poles and overhead cabling, panelboards, lighting fixtures, switches, and miscellaneous electrical equipment, as shown, specified, or required.

B. Remove existing electrical equipment and fixtures to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.

C. Remove or modify motor control centers and switchgear as shown or indicated. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.

D. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated. Motors, microprocessors and electronics, other electrical gear to be reused shall be stored in accordance with Section 01 66 00, Product Storage and Handling Requirements.

E. Cables in conduits to be removed shall be removed back to the power source or control panel, unless otherwise shown or indicated. Verify the function of each cable before disconnecting and removing.

F. Conduits, raceways, and cabling shall be removed where shown or indicated. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to ENGINEER. Exposed conduits, junction boxes, other electrical appurtenances, and their supports shall be disassembled and removed. Repair all areas of the Work to prevent rusting on exposed surfaces.

G. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.

H. Where shown or indicated, remove direct burial cable. Openings in buildings for entrance of direct burial cable shall be patched with repair mortar or other material approved by ENGINEER for this purpose and made watertight.

I. Existing poles and overhead cables shall be removed or abandoned as shown and specified. Existing substation(s) and poles owned by electric utility will be removed by the electric utility. Completely remove from the Site poles not owned by electric utility and shown or indicated for removal. Make necessary arrangements with electric utility for removal of utility company's transformers and metering equipment after new electrical system has been installed and energized.

J. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as OWNER's property, shall be removed and properly disposed off-Site as required.

3.10 DISPOSAL OF DEMOLITION DEBRIS

A. Remove from the Site all debris, waste, rubbish, and material resulting from demolition operations and equipment used in demolition Work. Comply with the General Conditions and Section 01 74 19, Construction and Demolition Waste Management.

B. Transportation and Disposal:
   1. Non-hazardous Material: Properly transport and dispose of non-hazardous demolition debris at appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Asbestos, PCBs, Petroleum, Hazardous Waste, Radioactive Material, or other material designated as hazardous in Laws and Regulations.
   2. Hazardous Material: When handling and disposal of hazardous materials is included in the Work, properly transport and dispose of hazardous materials in accordance with the Contract Documents and Laws and Regulations.

C. Submit to ENGINEER information required in this Section on proposed facility(ies) where demolition material will be recycled. Upon request, ENGINEER or OWNER, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist ENGINEER and OWNER.

END OF SECTION

SECTION 03 00 05

CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install concrete, reinforcing, and related materials.
   2. The Work includes:
      a. Providing concrete consisting of portland cement, fine and coarse aggregates, water, and approved admixtures; combined, mixed, transported, placed, finished, and cured.
      b. Fabricating and placing reinforcing, including ties and supports.
      c. Design, erection, and removal of formwork.
      d. Building into the concrete all sleeves, frames, anchorage devices, inserts, and other items required to be embedded in concrete.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed in the concrete Work.

C. Classifications of Concrete:
   1. Class “A” concrete shall be steel-reinforced and includes all concrete unless otherwise shown or indicated, and includes the following:
      a. Structural concrete for load bearing walls.
      b. Columns.
      c. Beams.
      d. Elevated floor slabs.
      e. Unlined or uncoated water/liquid containment structures.
   2. Class “B” concrete shall be placed without forms or with simple forms, with little or no reinforcing and includes the following:
      a. Concrete fill.
      b. Duct banks.
      c. Unreinforced encasements.
      d. Curbs and gutters.
      e. Sidewalks.
      f. Thrust blocks.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 224R, Control of Cracking in Concrete Structures.
   2. ACI 301, Specifications for Structural Concrete for Buildings.
   3. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305R, Specification for Hot Weather Concreting.
   5. ACI 306R, Cold Weather Concreting.
   6. ACI 309R, Guide for Consolidation of Concrete.
   7. ACI 318, Building Code Requirements for Structural Concrete and Commentary.

8. ACI 347, Guide to Formwork for Concrete.
9. ACI SP-66, ACI Detailing Manual.
10. ASTM A82/A82M, Specification for Steel Wire, Plain, for Concrete Reinforcement.
11. ASTM A185/A185M, Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
12. ASTM A615/A615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
13. ASTM C31/C31M, Practice for Making and Curing Concrete Test Specimens in the Field.
14. ASTM C33/C33M, Specification for Concrete Aggregates.
15. ASTM C39/C39M, Test Method for Compressive Strength of Cylindrical Concrete Specimens.
16. ASTM C42/C42M, Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
17. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
18. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
19. ASTM C143/C143M, Test Method for Slump of Hydraulic-Cement Concrete.
20. ASTM C150/C150M, Specification for Portland Cement.
21. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
22. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
23. ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C494/C494M, Specification for Chemical Admixtures for Concrete.
26. ASTM C579, Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
27. ASTM C881/C881M, Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
28. ASTM C1064/C1064M, Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
29. ASTM D1752, Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
30. ASTM E96/E96M, Test Methods for Water Vapor Transmission of Materials
31. ASTM E154, Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
32. CRD-C 572, U. S. Army Corps of Engineers Specification for Polyvinylchloride Waterstops.
33. CRSI 1MSP, Manual of Standard Practice.

1.3 QUALITY ASSURANCE

A. Laboratory Trial Batch:
   1. Employ independent testing laboratory currently certified by the Cement and Concrete Reference Laboratory and experienced in design and testing of concrete materials and mixes to perform material evaluation tests and to design concrete mixes.
   2. Each concrete mix design specified shall be verified by laboratory trial batch, unless indicated otherwise.
   3. Laboratory personnel shall be ACI-certified.
   4. Perform the following testing on each trial batch:
      a. Aggregate gradation for fine and coarse aggregates.
      b. Slump.
      c. Air content.

d. Compressive strength based on three cylinders each tested at seven days and at 28 days.

5. Submit for each trial batch the following information:
   a. Project identification name and number (if applicable).
   b. Date of test report.
   c. Complete identification of aggregate source of supply.
   d. Tests of aggregates for compliance with the Contract Documents.
   e. Scale weight of each aggregate.
   f. Absorbed water in each aggregate.
   g. Brand, type, and composition of cementitious materials.
   h. Brand, type, and amount of each admixture.
   i. Amounts of water used in trial mixes.
   j. Proportions of each material per cubic yard.
   k. Gross weight and yield per cubic yard of trial mixtures.
   l. Measured slump.
   m. Measured air content.
   n. Compressive strength developed at seven days and 28 days, from not less than three test cylinders cast for each seven day and 28-day test, and for each design mix.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. List of concrete materials and concrete mix designs proposed for use. Include results of tests performed to qualify the materials and to establish the mix designs. Do not start laboratory trial batch testing until this submittal is approved by ENGINEER.
      b. Laboratory Trial Batch Reports: Submit laboratory test reports for concrete cylinders, materials, and mix design tests.
      c. Concrete placement drawings showing the location and type of all joints.
      d. Drawings for fabricating, bending, and placing concrete reinforcing. Comply with ACI SP-66. For walls and masonry construction, provide elevations to a minimum scale of 1/4-inch to one foot. Show bar schedules, stirrup spacing, adhesive dowels, splice lengths, diagrams of bent bars, arrangements, and assemblies, as required for fabricating and placing concrete reinforcing.
   2. Product Data:
      a. Manufacturer's specifications with application and installation instructions for proprietary materials and items, including admixtures and bonding agents.
   3. Samples:
      a. Samples: Submit samples of materials as specified and as otherwise requested by ENGINEER, including names, sources, and descriptions.

B. Informational Submittals: Submit the following:
   1. Site Quality Control Submittals:
      a. Report of testing results for testing of field concrete cylinders for each required time period. Submit within 24 hours after completion of associated test. Test report shall include results of all testing required at time of sampling.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transportation, Delivery, and Handling:

1. Deliver concrete reinforcing products to Site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings on approved Shop Drawings.
2. Materials used for concrete shall be clean and free from foreign matter during transportation and handling, and kept separate until measured and placed into concrete mixer.
3. Implement suitable measures during hauling, piling, and handling to ensure that segregation of coarse and fine aggregate particles does not occur and grading is not affected.
4. Deliver grout materials from manufacturers in unopened containers that bear intact manufacturer labeling.
5. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage:
1. Store formwork materials above ground on framework or blocking. Cover wood for forms and other accessory materials with protective, waterproof covering. Provide for adequate air circulation or ventilation under cover.
2. Store concrete reinforcing materials to prevent damage and accumulation of dirt and excessive rust. Store on heavy wood blocking so that reinforcing does not come into contact with the ground. Space framework or blocking supports to prevent excessive deformation of stored materials.
3. Store concrete joint materials on platforms or in enclosures or covered to prevent contact with ground and exposure to weather and direct sunlight.
4. For storage of concrete materials, provide bins or platforms with hard, clean surfaces.
5. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: Provide the type of cement required by the environmental conditions and exposures defined by ASTM C150/C150M:
1. Type I/ Type IA: Normal/ Normal, air-entraining.
2. Type II/ Type IIA: Moderate sulfate resistance/ Moderate sulfate resistance, air-entraining.

B. Aggregates: ASTM C33/C33M.
1. Fine Aggregate: Clean, sharp, natural sand, manufactured sand or a combination thereof free of loam, clay, lumps, and other deleterious substances. Dune sand and bank run sand are unacceptable.
   a. Shall conform to the sieve analysis in accordance with ACI Standards with the following exceptions:
      1) The percent passing a No. 50 sieve shall not exceed 6%.
      2) The percent passing a No. 100 sieve shall be 0%.
2. Coarse Aggregate:
   a. Clean, uncoated, processed, uniformly and evenly graded aggregate containing no clay, mud, loam, or foreign matter.
   b. Coarse aggregate shall comply with the following:
      1) Sound, crushed, angular granitic stone.

2) Washed gravel, either natural or crushed. Slag, pit gravel, bank-run gravel, smooth or rounded stone are not allowed.

c. Coarse Aggregate Size:
   1) Reinforced Concrete: ASTM C33/C33M, Nos. 57 or 67, unless otherwise approved by ENGINEER.
   2) Unreinforced Slabs or Pavement: ASTM C33/ C33M, No. 467.

C. Water: Clean, potable.

D. Admixtures:
1. Air-Entraining Admixture: ASTM C260.
2. Water-Reducing Admixture: ASTM C494/C494M, Type A.
3. Water Reducing and Set-Adjusting Admixtures: ASTM C494/C494M, Types D and E.
4. High Range Water-Reducing Admixture: ASTM C494/C494M, Type F/G.
5. Use only admixtures that have been tested and approved in the mix designs.
6. Do not use calcium chloride in excess of 1% by cement weight. If concrete is used with reinforcing steel, no calcium chloride shall be used.
7. Do not use other admixtures containing chloride ions.

2.2 CONCRETE MIX

A. General:
1. Normal weight: 145 pounds per cubic foot.
2. Use air-entraining admixture in all concrete unless restricted by the manufacturer for floor hardness treatments or coating systems if specified. Provide not less than four percent, nor more than six percent, entrained air for concrete.

B. Proportioning and Design of Class “A” Concrete Mix:
1. Minimum compressive strength at 28 days: 4,500 psi.
2. Maximum water-cement ratio by weight: 0.42.
3. Minimum cement content: 564 pounds per cubic yard.

C. Proportioning and Design of Class “B” Concrete Mix:
1. Minimum compressive strength at 28 days: 3,500 psi.
2. Maximum water-cement ratio by weight: 0.50.
3. Minimum cement content: 517 pounds per cubic yard.

D. Slump Limits:
1. Proportion and design mixes to result in concrete slump at point of placement of not less than three inches and not more than five inches.
2. When using high-range water reducers, slump prior to addition of admixture shall not exceed three inches. Slump after adding admixture shall not exceed eight inches at point of placement.

E. Adjustment of Concrete Mixes:
1. Concrete mix design adjustments may be requested by CONTRACTOR when warranted by characteristics of materials, Site conditions, weather, test results, or other, similar circumstances.
2. Submit for ENGINEER’s approval laboratory test data for adjusted concrete mix designs, including compressive strength test results.
3. Implement adjusted mix designs only after ENGINEER’s approval.

4. Adjustments to concrete mix designs shall not result in additional costs to OWNER.

2.3 FORM MATERIALS

A. Provide form materials of wood, plywood, metal or material approved by Engineer with sufficient stability to withstand pressure of placed concrete without bow or deflection. CONTRACTOR shall be responsible for designing the formwork system to resist all applied loads including the pressures from fluid concrete and construction loads, including vibration during placement and rate of speed at which forms are to be filled.

B. Smooth Form Surfaces: Acceptable panel-type to provide continuous, straight, smooth, as-cast surfaces in accordance with ACI 301.

C. Unexposed Concrete Surfaces: Material to suit project conditions.

D. Provide 3/4-inch chamfer at all external corners. Chamfer is not required at re-entrant corners unless otherwise shown or indicated.

E. Form Ties:
   1. Provide factory-fabricated, removable, or snap-off metal form ties, that prevent form deflection and prevent spalling of concrete surfaces upon removal. Materials used for tying forms are subject to approval of ENGINEER.
   2. Unless otherwise shown or indicated, provide ties so that portion remaining within concrete after removal of exterior parts is at least 1.5 inches from outer surface of concrete. Unless otherwise shown or indicated, provide form ties that, upon removal, will leave a uniform, circular hole not larger than one-inch diameter in the concrete surface.
   3. Ties for exterior walls, below-grade walls, and walls subject to hydrostatic pressure shall be provided with waterstops.
   4. Wire ties are unacceptable.

2.4 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed bars.

B. Welded Wire Fabric: ASTM A185/A185M.

C. Steel Wire: ASTM A82/A82M.

D. Provide supports for reinforcing including bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing in place.
   1. Use wire bar-type supports complying with CRSI MSP1 recommendations, except as specified in this Section. Do not use wood, brick, or other unacceptable materials.
   2. For slabs on grade, use precast concrete blocks, four inches square minimum with compressive strength equal to or greater than the surrounding concrete, or supports with sand plates or horizontal runners where base materials will not support chair legs.
   3. For all concrete surfaces where legs of supports are in contact with forms, provide supports having either hot-dip galvanized, plastic-protected, or stainless steel legs in accordance with CRSI MSP1.
   4. Provide precast concrete supports over waterproof membranes.

E. Adhesive Dowels:

1. Dowels:
   a. Dowel reinforcing bars shall comply with ASTM A615, Grade 60.
2. Adhesive:
   a. Adhesive system shall use two-component adhesive mix.
   b. Epoxy adhesives shall comply with physical requirements of ASTM C881/C881M, Type IV, Grade 2 and 3, Class A, B, and C, except gel times.
   c. Adhesives shall have a current evaluation report by ICC Evaluation Service for use in both cracked and uncracked concrete with seismic recognition for SDC A through F as tested and assessed in accordance with ICC-ES AC308.
   d. Adhesives shall have minimum bond strength and minimum design bond strength (bond strength multiplied by strength reduction factor) in accordance with Table 03 00 05-A:

TABLE 03 00 05-A:
ADHESIVE BOND STRENGTH [1,2]

Anchor	Uncracked Concrete		Cracked Concrete	
Rod Diameter / Dowel Size	**Bond Strength (psi)**	**Design Bond Strength (psi)**	**Bond Strength (psi)**	**Design Bond Strength (psi)**
3/8-inch / #3	2040	1300	1090	700
1/2-inch / #4	1920	1200	920	560
5/8-inch / #5	1830	1150	710	390
3/4-inch / #6	1760	1050	710	460
7/8inch / #7	1670	900	610	340
1-inch / #8	1650	1050	850	460
- / #9	1900	1000	800	400
1.25-inch/ #10	1580	1000	730	400

Table Notes:
1. Bond strengths listed for hammer-drilled, dry hole.
2. Bond strengths listed for maximum short term concrete temperature of 110 degrees F and maximum long term concrete temperature of 75 degrees F.

2.5 RELATED MATERIALS

A. Waterstops:
   1. PVC Waterstops:
      a. Manufacturers: Provide products of one of the following:
         1) W.R. Meadows, Inc.
         2) Greenstreak Plastic Products Company.
         3) Or equal.
      b. Waterstops shall comply with CRD-C 572. Do not use reclaimed or scrap material.
      c. Minimum Thickness: 3/8-inch.
      d. Provide waterstops with minimum of seven ribs equally spaced at each end on each side with the first rib located at the edge. Each rib shall be minimum 1/8-inch in height.
      e. Construction Joints: Waterstops shall be six-inch wide flat-strip type.
      f. Expansion Joints: Waterstops shall be nine-inch wide centerbulb type.
   2. Hydrophilic Waterstops:
      a. Products and Manufacturers: Provide one of the following:

1) Duroseal Gasket, by BBZ USA, Inc.
2) Adeka Ultraseal MC-2010M, by Asahi Denka Kogyo K.K.
3) Hydrotite, by Greenstreak Plastic Products Company.
4) Or equal.

b. Hydrophilic waterstop materials shall be bentonite-free and shall expand by minimum of 80 percent of dry volume in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
c. Waterstop material shall be composed of resins and polymers that absorb water and cause a completely reversible and repeatable increase in volume.
d. Waterstop material shall be dimensionally stable after repeated wet-dry cycles with no deterioration of swelling potential.
e. Select material in accordance with manufacturer's recommendations for type of liquid to be contained.
f. Minimum cross-sectional dimensions: 3/16-inch by 3/4-inch.
g. Location of hydrophilic waterstops shall be as shown or indicated on the Drawings, or where approved by ENGINEER.
h. Hydrophilic Sealant: Shall adhere firmly to concrete, metal, and PVC in dry or damp condition and be indefinitely elastic when cured.
1) Products and Manufacturers: Provide one of the following:
a) Duroseal Paste, by BBZ USA, Inc.
b) Adeka Ultraseal P-201, by Asahi Denka Kogyo K.K.
c) Hydrotite, by Greenstreak Plastic Products Company.
d) Or equal.

B. Membrane-Forming Curing Compound: ASTM C309, Type II.

C. Epoxy Bonding Agent:
1. Two-component epoxy resin bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sikadur 32, Hi-Mod LPL, by Sika Corporation.
b. Eucopoxy LPL, by the Euclid Chemical Company.
c. Or equal.

D. Epoxy-Cement Bonding Agent:
1. Three-component blended epoxy resin-cement bonding agent.
2. Products and Manufacturers: Provide one of the following:
a. Sika Armatec 110 EpoCem, by Sika Corporation.
b. Duralprep A.C., by Euclid Chemical Company.
c. Or equal.

E. Preformed Expansion Joint Filler:
1. Provide preformed expansion joint filler complying with ASTM D1752, Type I (sponge rubber) or Type II (cork).

F. Joint Sealant and Accessories:
1. For joint sealants and accessories used on isolation joints, control joints, and expansion joints, refer to Section 07 92 00, Joint Sealants.

2.6 GROUT

A. Non-shrink Grout:

1. Pre-packaged, non-metallic, cementitious grout requiring only the addition of water at the Site. In accordance with ASTM C1107.
2. Minimum 28-day Compressive Strength: 7,500 psi.
3. Bond Strength: 1,350 to 1,700 psi.
4. Percent Expansion: 0.25% to 0.75%.
5. Products and Manufacturers: Provide one of the following:
    a. NS Grout by Euclid Chemical Company.
    b. Set Grout by Master Builders, Inc.
    c. Embeco 636 by Master Builders, Inc.
    d. d. NBEC Grout by Five Star Products, Inc.
    e. Or equal.

2.7 MORTAR

A. Mortar uses in sanitary sewer manholes shall be hydraulic cement mortar in accordance with ASTM C-398.

B. Mortar used in water meter vaults and water valve vaults shall be Type M in accordance with ASTM C-270.

PART 3 EXECUTION

3.1 INSPECTION

A. CONTRACTOR shall examine the substrate and the conditions under which the Work will be performed and notify ENGINEER in writing of unsatisfactory conditions. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 FORMWORK

A. Construct formwork in accordance with ACI 347 such that concrete members and structures are of correct size, shape, alignment, elevation, and position.

B. Provide openings in formwork to accommodate the Work of other trades. Accurately place and securely support items required to be built into formwork.

C. Clean and adjust forms prior to placing concrete. Apply form release agents or wet forms as required. Re-tighten forms during and after concrete placing, when required, to eliminate cement paste leaks.

D. Removing Formwork:
1. Comply with ACI 301 and ACI 347, except as otherwise indicated in the Contract Documents.
2. Do not remove formwork and shoring until supported concrete members have acquired minimum of 90 percent of specified compressive strength. Results of suitable quality control tests of field-cured specimens may be submitted to ENGINEER for review as evidence that concrete has attained sufficient strength for removal of supporting formwork and shoring prior to removal times indicated in the Contract Documents.
3. Removal time for formwork is subject to ENGINEER's acceptance. Forms shall be left in place for a minimum of 7 days.

4. Repair form tie-holes following in accordance with ACI 301.
5. Do not remove formwork and backfill before end of curing period without approval of Engineer. In such cases where Engineer approves early removal of forms, newly-exposed surfaces shall be cured in accordance with Part 3 of this specification.

3.3 REINFORCING, JOINTS, AND EMBEDDED ITEMS

A. Comply with the applicable recommendations of Laws and Regulations and standards referenced in this Section, including CRSI MSP1, for details and methods of placing and supporting reinforcing.

B. Clean reinforcing to remove loose rust and mill scale, earth, ice, and other materials which act to reduce or destroy bond between reinforcing material and concrete.

C. Position, support, and secure reinforcing against displacement during formwork construction and concrete placing. Locate and support reinforcing by means of metal chairs, runners, bolsters, spacers, and hangers, as required.
   1. Place reinforcing to obtain minimum concrete coverages as shown on the Drawings and as required in ACI 318. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcing accurately in position during concrete placing. Set with ties so that twisted ends are directed away from exposed concrete surfaces.
   2. Do not secure reinforcing to formwork using wire, nails or other ferrous metal. Metal supports subject to corrosion shall not be in contact with formed or exposed concrete surfaces.

D. Provide sufficient quantity of supports of strength required to carry reinforcing. Do not place reinforcing more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

E. Splices: Provide standard reinforcing splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements shown or indicated for minimum lap of spliced bars, as shown on the Drawings.

F. Install welded wire fabric in lengths as long as practical, lapping adjoining sections a minimum of one full mesh.

G. Do not place concrete until reinforcing is inspected and ENGINEER indicates that conditions are acceptable for placing concrete. Concrete placed in violation of this paragraph shall be rejected. Notify ENGINEER in writing at least two working days prior to proposed concrete placement.

H. Joints:
   1. Provide construction, isolation, expansion, and control joints as indicated or required. Locate construction joints so as to not impair the strength and appearance of the structure. Place isolation and control joints in slabs-on-grade to stabilize differential settlement and random cracking.
   2. In walls, locate joints at a maximum spacing of 40 feet and approximately 12 feet from corners.
   3. In foundation slabs and slabs-on-grade, locate joints at intervals of approximately 40 feet.
   4. In mats and structural slabs and beams, locate joints in compliance with ACI 224R.

5. Locations of joints shall be in accordance with the Contract Documents and as approved by ENGINEER in the Shop Drawings.
6. Where construction joints are indicated to be roughened, intentionally roughen surfaces of previously-placed concrete to amplitude of 1/4-inch.

I. Installation of Embedded Items: Do not embed in concrete uncoated aluminum items. Where aluminum items are in contact with concrete surfaces, coat aluminum to prevent direct contact with concrete.

J. Adhesive Dowels:
1. Adhesive dowels shall be reinforcing bar dowels set in an adhesive in hole drilled into hardened concrete. Comply with adhesive system manufacturer's installation instructions regarding hole diameter, drilling method, embedment depth required to fully develop required tensile strength, and hole cleaning and preparation instructions. Unless more-stringent standards are required by adhesive system manufacturer, comply with the following.
2. Drill holes to adhesive system manufacturer's recommended diameter and depth to develop required tensile strength. Holes shall not be more than 1/4-inch greater than nominal bar diameter, and hole depth shall not be less than twelve times nominal bar diameter. Hammer-drill holes. Cored holes are not allowed.
3. Embedment depths shall be based on concrete compressive strength of 2,000 psi when embedded in existing concrete, and 4,000 psi when embedded in new concrete.
4. Determine location of existing reinforcing steel in vicinity of proposed holes prior to drilling. Adjust location of holes to be drilled to avoid drilling through or damaging existing reinforcing bars only when approved by ENGINEER.
5. Before setting adhesive dowel, hole shall be free of dust and debris using method recommended by adhesive system manufacturer. Hole shall be brushed, with manufacturer-approved brush and blown clean with clean, dry, oil-free compressed air to remove dust and loose particles. Hole shall be dry as defined by adhesive system manufacturer.
6. Inject adhesive into hole through injection system mixing nozzle and necessary extension tubes, placed to bottom of hole. Withdraw discharge end as adhesive is placed, but keep end of tube immersed to prevent forming air pockets. Fill hole to depth that ensures that excess material is expelled from hole during dowel placement.
7. Twist dowels during insertion into partially-filled hole to guarantee full wetting of bar surface with adhesive. Insert bar slowly to avoid developing air pockets.

3.4 CONCRETE PLACING

A. Site Mixing: Use drum-type batch machine mixer, mixing not less than 1.5 minutes for one cubic yard or smaller capacity. Increase required mixing time by minimum of 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete: Comply with ASTM C94/C94M.

C. Concrete Placing:
1. Place concrete in a continuous operation within planned joints or sections in accordance with ACI 304R.
2. Do not begin placing concrete until work of other trades affecting concrete is completed.
3. Wet concrete and subgrade surfaces to saturated surface dry condition immediately prior to placing concrete.

4. Deposit concrete as near its final location as practical to avoid segregation due to re-handling or flowing.
5. Avoid separation of the concrete mixture during transportation and placing. Concrete shall not free-fall for distance greater than four feet during placing.
6. Complete concrete placing within 90 minutes of addition of water to the dry ingredients.

D. Consolidate placed concrete in accordance with ACI 309R using mechanical vibrating equipment supplemented with hand rodding and tamping, such that concrete is worked around placing and other embedded items and into all parts of formwork. Insert and withdraw vibrators vertically at uniformly-spaced locations. Do not use vibrators to transport concrete within the formwork. Vibration of formwork or placing is not allowed.

E. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placing, and curing.
1. In hot weather comply with ACI 305R.
2. In cold weather comply with ACI 306R.

3.5 QUALITY OF CONCRETE WORK

A. Make concrete solid, compact, smooth, and free of laitance, cracks, and cold joints.

B. Concrete for liquid-retaining structures and concrete in contact with earth, water, or exposed directly to the elements shall be watertight.

C. Cut out and properly replace to extent directed by ENGINEER, or repair to satisfaction of ENGINEER, surfaces that contain cracks or voids, are unduly rough, or are in defective in any way. Patches or plastering are unacceptable.

D. Repair, removal and replacement of defective concrete directed by ENGINEER shall be at no additional cost to OWNER.

3.6 CURING

A. Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 7 hours. Continue curing by using moisture-retaining cover or membrane-forming curing compound, or by keeping exposed surfaces moist continuously for entire curing period. Cure formed surfaces by moist curing until formwork is removed. Provide protection, as required, to prevent damage to exposed concrete surfaces. Total curing period shall not be less than seven days. Curing methods and materials shall be compatible with scheduled finishes.

3.7 FINISHING

A. Slab Finish:
1. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently. Use a wood float only. Check and level surface plane to a tolerance not exceeding 1/4-inch in ten feet when tested with a ten foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float the surface to a uniform, smooth, granular

texture. Slab surfaces shall receive a float finish. Provide additional trowel finishing as required in this Section.

2. After floating, begin first trowel finish operation using power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over the surface.
3. Consolidate concrete surface by the final hand troweling operation. Finish shall be free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in ten feet when tested with a ten-foot straightedge. Grind smooth surface defects that would telegraph through applied floor covering system.
4. Use trowel finish for the following:
   a. Interior exposed slabs, unless otherwise shown or indicated.
   b. Apply non-slip broom finish, after troweling, to exterior concrete slab and elsewhere as shown.

B. Apply chemical floor hardener to exposed interior concrete floor areas when cured and dry, in accordance with hardener manufacturer's instructions.

C. Formed Finish:
1. Provide smooth form concrete finish at exposed surfaces. Use largest practical form panel sizes to minimize form joints. Exposed surfaces include interior water-contacting surfaces of tanks, whether or not directly visible. All surfaces shall be considered as exposed, unless buried or covered with permanent structural or architectural material. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/8-inch in height. Where surface will be coated or will receive further treatment, remove all fins flush with concrete surface.
2. Provide rough form finish at all unexposed surfaces. After removing forms, patch form tie holes and defects in accordance with ACI 301. Remove fins exceeding 1/2-inch in height.

3.8 GROUT PLACING

A. Place grout as shown and indicated, and in accordance with grout manufacturer's instructions and recommendations. If grout manufacturer's instructions conflict with the Contract Documents, notify ENGINEER and not proceed until obtaining ENGINEER's clarification.

B. Dry-packing is not allowed, unless otherwise indicated.

C. Manufacturers of proprietary grout materials shall make available upon 72 hours notice the services of qualified, full-time, factory-trained employee to aid in ensuring proper use of grout materials at the Site.

D. Placing grout shall comply with temperature and weather limitations described in Article 3.4 of this Section.

3.9 FIELD QUALITY CONTROL

A. Site Testing Services:
1. Employ independent testing laboratory to perform field quality control testing for concrete. ENGINEER will direct where samples are obtained.
2. Testing laboratory will provide all labor, material, and equipment required for sampling and testing concrete, including: scale, glass tray, cones, rods, molds, air tester, thermometer, and other incidentals required.

3. Provide curing and necessary cylinder storage in accordance with Section 01 45 29, Testing Laboratory Services.

B. Quality Control Testing During Construction:
   1. Perform sampling and testing for field quality control during concrete placing, as follows:
      a. Sampling Fresh Concrete: ASTM C172.
      b. Slump: ASTM C143/C143M; one test for each concrete load at point of discharge.
      c. Concrete Temperature: ASTM C1064/C1064M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed. Test each load when time from batching to placement exceeds 75 minutes.
      d. Air Content: ASTM C231; one for every two concrete load at point of discharge, and when a change in the concrete is observed.
      e. Unit Weight: ASTM C138/C138M; one for every two concrete loads at point of discharge, and when a change in the concrete is observed.
      f. Compression Test Specimens:
         1) In accordance with ASTM C31/C31M, make one set of compression cylinders for each 50 cubic yards of concrete, or fraction thereof, of each mix design placed each day. Each set shall be four standard cylinders, unless otherwise directed by ENGINEER.
         2) Cast, store, and cure specimens in accordance with ASTM C31/C31M.
      g. Compressive Strength Tests:
         1) In accordance with ASTM C39/C39M; one specimen tested at seven days, and three specimens tested at 28 days.
         2) Concrete that does not comply with strength requirements shall be considered as defective Work.
      h. Submit test results from certified by testing laboratory to ENGINEER within 24 hours of completion of test.
      i. When there is evidence that strength of in-place concrete does not comply with the Contract Documents, CONTRACTOR shall employ the services of concrete testing laboratory to obtain cores from hardened concrete for compressive strength determination. Cores and tests shall comply with ASTM C42/C42M and the following:
         1) Testing of Adhesive Dowels: CONTRACTOR shall employ testing agency to perform field quality control testing of drilled dowel installations. After adhesive system manufacturer's recommended curing period and prior to placing connecting reinforcing, proof-test for pullout ten percent of adhesive dowels installed. Adhesive dowels shall be tensioned to 60 percent of specified yield strength. Where dowels are located less than six bar diameters from edge of concrete, ENGINEER shall determine tensile load required for test. If one or more dowels fail, retest all dowels installed for the Work. Dowels that fail shall be reinstalled and retested at CONTRACTOR's expense.

END OF SECTION

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish miscellaneous metal fabrications including surface preparation and shop priming.
   2. The Work also includes:
      a. Providing openings in miscellaneous metal fabrications to accommodate the Work under this and other Sections, and attaching to miscellaneous metal fabrications all items such as sleeves, bands, studs, fasteners, and all items required for which provision is not specifically included under other Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the Work to be installed with, or attached to, miscellaneous metal fabrications Work.
   2. Hot-dip Galvanizing: Coordinate with steel fabricator detailing for and fabrication of assemblies to be hot-dip galvanized, to minimize distortion during galvanizing process.

C. Related Sections:
   1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI A14.3, Ladders – Fixed –Safety Requirements.
   2. ANSI Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components.
   3. ASTM A36/A36M, Specification for Carbon Structural Steel.
   4. ASTM A53/A53M, Specification for Pipe Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   5. ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   6. ASTM A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   7. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.
   8. ASTM A320/A320M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
   9. ASTM A384/A384M Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
   10. ASTM A500, Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   11. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
   12. ASTM A793, Specification for Rolled Floor Plate, Stainless Steel.
   13. ASTM A992/A992M, Specification for Structural Steel Shapes.

14. ASTM A1011/A1011M, 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.
15. ASTM B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
16. ASTM B211, Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire.
17. ASTM B221, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
18. ASTM B308/B308M, Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
19. ASTM B429, Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
20. ASTM B632/B632M, Specification for Aluminum-Alloy Rolled Tread Plate.
21. AWS D1.1/D1.1M, Structural Welding Code – Steel.
22. AWS D1.2/D1.2M, Structural Welding Code – Aluminum.
23. AWS D1.6, Structural Welding Code – Stainless Steel.
24. NAAMM, Metal Finishes Manual.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Welding:
      a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, D1.2/D1.2M, or D1.6, as applicable.
      b. When requested by ENGINEER, provide certification that each welder employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within previous 12 months. Ensure that all certifications are current.

B. Regulatory Requirements: Conform to the following:
   1. 29 CFR 1910, Occupational Health and Safety Standards.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and erection details for assemblies of miscellaneous metal Work. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings and templates for locating and installing miscellaneous metal items and anchorage devices.
   2. Product Data:
      a. Copies of manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for products to be used in miscellaneous metal Work.

B. Informational Submittals: Submit the following:
   1. Test and Evaluation Reports:
      a. Mill test report that indicate chemical and physical properties of each type of material, when requested by ENGINEER.
   2. Qualifications Statements:
      a. Copies of welder's certifications, when requested by ENGINEER.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver products to Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in other construction in ample time to prevent delaying the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel:
   1. W-Shapes and WT-Shapes: ASTM A992/A992M.
   2. S-Shapes and Channels: ASTM A572/A572M, Grade 50.
   3. Hollow Structural Sections: ASTM A500, Grade B.
   4. Angles, Plates, Bars: ASTM A36/A36M.
   5. Steel Pipe: ASTM A53/A53M, Grade B.

B. Aluminum:
   1. Aluminum Shapes: ASTM B308/B308M, Alloy 6061-T6, ASTM B 221, Alloy 6061-T6.
   2. Aluminum Tubes and Pipes: ASTM B429, Alloy 6061-T6.
   3. Aluminum Bars and Rod: ASTM B211, Alloy 6061-T6.
   4. Aluminum Plates: ASTM B209, Alloy 6061-T6.

C. Stainless Steel:
   1. Plates and Sheets: ASTM A240/A240M, Type 304L or Type 316 stainless steel.
   2. Submerged or Intermittently Submerged: Type 316 stainless steel.
   3. Non-submerged: Type 304L stainless steel.

D. Stainless Steel Fasteners and Fittings: ASTM A 320/A 320M, Type 304L or Type 316 Stainless Steel.

E. Zinc-coated Hardware: ASTM A153/A153M.

2.2 MISCELLANEOUS METAL ITEMS

A. Shop Assembly:
   1. Pre-assemble items in the shop to the greatest extent possible to minimize field-splicing and field-assembly of units at the Site. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Aluminum Ladders:
   1. Fabricate ladders for locations shown or indicated with dimensions, spacing, details, and anchorages as shown and specified. Comply with OSHA 29 CFR 1910 and ANSI A14.3, except as otherwise shown or specified.
      a. Unless otherwise shown, provide 1.5-inch diameter continuous side rails, spaced at least 1.5 feet apart.
      b. Provide extruded square rungs, spaced maximum of 12 inches on centers, with non-slip surface on top of each rung. Adhesive strips for non-slip surfaces are not acceptable.

2. Fit rungs in centerline of side rails, plug weld, and grind smooth on outer rail faces.
3. Support each ladder at top and bottom and at intermediate points spaced not more than five feet on centers.
4. Use welded or bolted brackets, designed for adequate support and anchorage, and to hold ladder clear of wall surface with minimum of seven inches between wall and centerline of rungs.
5. Unless otherwise shown or approved by ENGINEER, extend rails 3.5 feet above top rung, and return rails to wall or structure, unless other secure handholds are provided. If adjacent structure does not extend above top rung, goose-neck extended rails back to structure to provide secure ladder access.
6. Use extruded aluminum conforming to alloy and temper 6061-T6.

C. Shelf Angles:
1. Provide structural steel shelf angles of sizes shown, for attachment to concrete or masonry construction. Provide slotted holes to receive 3/4-inch bolts, spaced not more than six inches from ends and not more than 2.0 feet on centers, unless otherwise shown.
   a. Provide galvanized shelf angles on outdoor construction.
2. Provide wedge-type concrete inserts, complete with fasteners, for attachment of shelf angles to cast-in-place concrete.

D. Aluminum Stair Nosings:
1. Manufacturers: Provide products of one of the following:
   a. Supergrit Type 241BF by Wooster Products, Inc.
   b. Or equal.
2. Fabricate extruded aluminum nosing of sizes and configurations as shown on the Drawings.
   a. Unless otherwise shown, provide ribbed abrasive filled type, using black abrasive filler.
3. Provide anchors for embedding in concrete, either integral or applied to treads, as standard with manufacturer.

E. Bollards:
1. Provide Schedule 80 galvanized steel pipe filled with concrete as shown on the Drawings. Paint as required in accordance with manufacturer's paint standards. Unless otherwise shown or specified, finish-paint bollard "Safety Yellow."

F. Miscellaneous Framing and Supports:
1. Provide miscellaneous metal framing and supports that are not part of structural steel framework and are required to complete the Work.
2. Fabricate miscellaneous units to sizes, shapes, and profiles shown on the Drawings or, if not shown, of required dimensions to receive adjacent grating, plates, tanks, doors, and other work to be retained by the framing.
3. Except as otherwise shown, fabricate from structural shapes, plates, and bars, of all-welded construction using mitered corners, welded brackets, and splice plates and minimum number of joints for field connection.
4. Cut, drill, and tap units to receive hardware and similar items to be anchored to the Work.
5. Furnish units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units are to be installed after concrete is placed.
   a. Except as otherwise shown, space anchors, 2.0 feet on centers, and provide units the equivalent of 1.25-inch by 1/4-inch by eight-inch strips.
   b. Galvanize exterior miscellaneous frames and supports.

c. Where shown or indicated, galvanize miscellaneous frames and supports that are not to be installed outdoors.

6. Miscellaneous steel framing and supports shall be hot-dip galvanized and finish-painted, unless otherwise shown or indicated.
7. Surface preparation and painting of galvanized surface shall conform to manufacturer's painting standards.

G. Fasteners and Hardware: Provide Type 316 stainless steel fasteners for aluminum fabrications and zinc-coated hardware for galvanized fabrications, unless otherwise shown or specified.

2.3 FINISHING

A. Surface Preparation and Shop Priming: Perform surface preparation and apply primer coat to miscellaneous metal fabrications in the shop. Conform surface preparation and shop priming to manufacturer's standards.

B. Galvanizing:
1. Galvanizing of fabricated steel items shall comply with ASTM A123/A123M.
2. Details of fabrication of steel items and assemblies to be hot-dip galvanized shall conform to recommendations of ASTM A384/A384M to minimize the potential for distortion.

C. Aluminum Finish: Provide an Architectural Class 1 anodized finish, AA-M32C22-A41, as specified in NAAMM Metal Finishes Manual. Color of finish shall be as approved by ENGINEER.

2.4 SOURCE QUALITY CONTROL

A. Tests and Inspections:
1. Materials and fabrication procedures shall be subject to inspection and tests in the mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing materials and fabrication procedures complying with the Contract Documents.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine conditions under which the Work is to be performed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install miscellaneous metal fabrications accurately in location, alignment, and elevation, plumb, level, true, and free of rack, measured from established lines and levels. Brace temporarily or anchor temporarily in formwork where fabrications are to be built into concrete, masonry, or other construction.

B. Anchor securely as shown and as required for the intended use, using concealed anchors where possible.

C. Fit exposed connections accurately together to form tight, hairline joints. Field-weld steel connections that are not to be exposed joints and cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1/D1.1M, D1.2/D1.2M and D1.6, as applicable to the material being welded. Grind steel joints smooth and touch-up shop paint coat. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Protection of Aluminum from Dissimilar Materials:
   1. Coat surfaces of aluminum that will contact dissimilar materials such as concrete, masonry, and steel, in accordance with manufacturer's coating standards.

END OF SECTION

SECTION 05 56 00

METAL CASTINGS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install metal castings.
   2. Castings include metal items that are not part of miscellaneous metal fabrications or metal systems in other Specifications Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before metal castings Work.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A48/A48M, Specification for Gray Iron Castings.
   2. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   3. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have at least five years experience manufacturing products substantially similar to those required and shall be able to submit documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all frame, lid or cover and grate products included in this Section regardless of component manufacturer, from a single castings manufacturer.
   2. Castings manufacturer shall review and approve or prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. Components shall be constructed for specified service conditions and shall be integrated into overall assembly by castings manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Fabrication and installation of all casting assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Include setting drawings for location and installation of castings and anchorage devices.
   2. Product Data:

a. Copies of manufacturer's catalog information for the products proposed for use, specifications, load tables, dimension diagrams, anchor details, and installation instructions.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Furnish certification, signed by authorized officer of CONTRACTOR and notarized, stating that all components are furnished by the same manufacturer.
      b. Manufacturer's certification that the casting or lot of castings was made, sampled, tested and inspected in accordance with ASTM A48.
   2. Qualifications Statements: Submit qualifications for the following:
      a. Manufacturer, when required by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Deliver products to the Site to ensure uninterrupted progress of the Work. Deliver anchorage materials to be embedded in concrete in ample time to prevent delaying the Work.
   2. Comply with Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
   1. Protect materials from corrosion and deterioration.
   2. Comply with Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide products from the following manufacturers:
   1. Neenah Foundry Company.
   2. EJ (formerly East Jordan Ironworks).
   3. Or equal.

B. Material: ASTM A48/A48M, Class 35 B.

C. Products:
   1. Round Manhole Frame with Solid Lid.
   2. Round Manhole Frame with Solid Bolted Lid.
   3. Round Manhole Frame with Solid Lid – Flush Top.
   4. Catch Basin Frame with Grate.
   5. Curb Inlet Frame Grate and Curb Box.
   6. Valve Box Frame and Lid.

2.2 FABRICATION

A. Fabrication, General:

1. Castings shall be of uniform quality, free of sand holes, gas holes, shrinkage cracks, and other surface defects.
2. Castings shall be ground smooth and well-cleaned by shot blasting in the shop.
3. Design and fabricate round frames and covers to prevent rocking and rattling under traffic loads that will be imposed in actual use.
4. Fabricate castings true to pattern so that component parts fit together.
5. Each casting shall be identifiable and, depending on its size, shall indicate the following: name of producing foundry, ASTM material designation, individual part number, and cast or heat date. Castings shall include all lettering shown or indicated on the Drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be performed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Comply with casting manufacturer's printed instructions and the Contract Documents. Where castings are installed on precast concrete, fabricated fiberglass, or other fabricated products, install casting in accordance with requirements of manufacturer of product on which casting will be installed.

B. Set castings accurately to required location, alignment, and elevation, plumb, level, true and free of rack, measured from established lines and levels. Where applicable, brace temporarily or anchor temporarily in formwork.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, tools, equipment, and incidentals as shown, specified, and required to furnish and install joint sealants.
   2. Extent of each type of calking and sealant is shown or indicated and includes the following:
      a. Interior and exterior joints in equipment and construction systems not filled by another material, and that are not required to be open for operation.
      b. Exposed-to-view joints of all fire-rated sealants.
      c. Joints specified to be recalked.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate installation of items to be installed with or before joint sealants.
   2. Coordinate final selection of joint sealants so that materials are compatible with all calking and sealant substrates specified.

C. Related Sections:
   1. Section 03 00 05, Concrete.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM C510, Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants.
   2. ASTM C661, Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.
   3. ASTM C793, Test Method for Effects of Accelerated Weathering on Elastomeric Joint Sealants.
   4. ASTM C794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
   5. ASTM C920, Specification for Elastomeric Joint Sealants.
   6. ASTM C1021, Practice for Laboratories Engaged in Testing Building Sealants.
   7. ASTM C1087, Test method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems.
   8. ASTM C1193, Guide for Use of Joint Sealants.
   9. ASTM C1247, Practice for Durability of Sealants Exposed to Continuous Immersion in Liquids.
   10. BAAQMD Regulation 8, Rule 51.
   11. FS TT-S-00227, Sealing Compound: Elastomeric Type, Multi-component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
   12. FS TT-S-00230 Sealing Compound: Elastomeric Type, Single Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
   13. NSF/ANSI Standard 61, Drinking Water System Components - Health Effects.
   14. SCAQMD Rule 1168.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Installer:
      a. Engage a single installer, approved by product manufacturer, regularly engaged in calking and sealant installation and with successful experience in applying types of products required, and who employs only tradesmen with specific skill and successful experience in the type of Work required.
   2. Testing Laboratory:
      a. Furnish services of independent testing laboratory qualified according to ASTM C1021, for conducting testing required.

B. Component Supply and Compatibility:
   1. Obtain materials only from manufacturers who will, if required:
      a. Test joint sealants for compatibility with substrates for conformance with FS-TT-S-00227, and recommend remedial procedures as required.
   2. Before purchasing each sealant, investigate its compatibility with joint surfaces, joint fillers, and other materials in joint system. Provide products that are fully compatible with actual installation condition, verified by manufacturer's published data or certification, and as shown on approved Shop Drawings and other approved submittals.

C. Product Testing: Provide test results of laboratory pre-construction compatibility and adhesion testing, as specified in Article 3.1 of this Section, by qualified testing laboratory, based on testing of current sealant formulations within a 36-month period preceding the Notice to Proceed for the Work.
   1. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920 and, where applicable, to other standard test methods.
   2. Test other joint sealants for compliance using specified post-construction field adhesion test.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Schedule of joint sealants installation, indication each specific surface where calking or sealants are to be provided and the material proposed for each application.
   2. Product Data:
      a. Copies of manufacturer's data sheets including color charts, specifications, recommendations, and installation instructions for each type of sealant, calking compound, and associated miscellaneous material required. Include manufacturer's published data, indicating that each product complies with the Contract Documents and is intended for the applications shown or indicated.
      b. Product test reports.
   3. Samples:
      a. Each type of actual cured material of each calking and sealant specified, in each of manufacturer's standard colors.
      b. Samples will be reviewed by ENGINEER for color and texture only. Compliance with other requirements is responsibility of CONTRACTOR.

B. Informational Submittals: Submit the following:
   1. Certificates:

a. Certify that materials are suitable for intended use and materials meet or exceed requirements of the Contract Documents.
b. Certification from manufacturer that products furnished are appropriate for surfaces and conditions to which they will be applied.
c. Certify that applicator is approved by manufacturer.

2. Field Quality Control Submittals:
   a. Results of tests on job mock-ups.
   b. Pre-construction and post-construction field test reports.
   c. Compatibility and adhesion test reports.
   d. Contractor's Field Test Report Logs:
      1) Indicate time present at the Site.
      2) Include observations and results of field tests, and document compliance with manufacturer's installation instructions and supplemental instructions provided to installers.
3. Qualifications: Submit qualifications for:
   a. Installer.
   b. Testing laboratory (if not already submitted under Section 01 45 29, Testing Laboratory Services).

C. Closeout Submittals: Submit the following:
1. Operation and Maintenance Data:
   a. Recommended inspection intervals.
   b. Instructions for repairing and replacing failed sealant joints.
2. Warranty: Submit written warranties as specified in this Section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with Section 01 65 00, Product Delivery Requirements, and Section 01 66 00, Product Storage and Handling Requirements, and the following:
1. Delivery of Products:
   a. Deliver products in calking and sealant manufacturer's original unopened, undamaged containers, indicating compliance with approved Shop Drawings and approved Sample color selections.
   b. Include the following information on label:
      1) Name of material and Supplier.
      2) Formula or Specification Section number, lot number, color and date of manufacture.
      3) Mixing instructions, shelf life, and curing time, when applicable.
2. Storage of Products:
   a. Do not store or expose materials to temperature above 90 degrees F or store in direct sunlight.
   b. Do not use materials that are outdated as indicated by shelf life.
   c. Store sealant tape in manner that will not deform tape.
   d. In cool or cold weather, store containers for sixteen hours before using in temperature of approximately 75 degrees F.
   e. When high temperatures prevail, store mixed sealants in a cool place.
3. Handling:
   a. Do not open containers or mix components until necessary preparatory Work and priming are complete.

1.6 JOB CONDITIONS

A. Environmental Conditions:
   1. Do not install joint sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
   2. Proceed with the Work when forecasted weather conditions are favorable for proper cure and development of high-early bond strength.
   3. Where joint width is affected by ambient temperature variations, install elastomeric sealants when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
   4. When high temperatures prevail, avoid mixing sealants in direct sunlight.
   5. Supplemental heat sources required to maintain both ambient and surface temperatures within the range recommended by manufacturer for material applications are not available at the Site.
   6. Provide supplemental heat and energy sources, power, equipment, and operating, maintenance, and temperature monitoring personnel.
   7. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas of calking, sealants, and painting Work, and areas where OWNER's personnel or construction personnel may work. Properly locate and vent such heat sources to outdoors so that joint sealants and other Work are unaffected by exhaust.

1.7 WARRANTY

A. Provide written warranty, signed by manufacturer and CONTRACTOR, agreeing to repair or replace sealants that fail to perform as air-tight and watertight joints; or fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability; or appear to deteriorate in any other manner not clearly specified in approved Shop Drawings and other submittals, as an inherent quality of material for exposure indicated.
   1. Provide manufacturer warranty for period of one year from date of Substantial Completion of joint sealants Work.
   2. Provide installer warranty for period of two years from date of Substantial Completion of joint sealants Work.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Provide elastomeric joint sealants for interior and exterior joint applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. VOC Performance Criteria:
   1. VOC content of sealants used shall comply with current VOC content limits of SCAQMD Rule 1168. Sealants used as fillers shall comply with or exceed requirements of BAAQMD Regulation 8, Rule 51.
      a. Sealants: 250 g/L.
      b. Sealant Primers for Nonporous Substrates: 250 g/L.
      c. Sealant Primers for Porous Substrates: 775 g/L.

C. Provide colors selected by ENGINEER from calking and sealant manufacturer's standard and custom color charts. "Or equal" manufacturers shall provide same generic products and colors as available from manufacturers specified.

2.2 MATERIALS

A. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Potable Water or Water That Will be Treated to Become Potable:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c NS by Sika Corporation.
         2) Or equal.
      b. Two-component, moisture cured, gun grade, polyurethane sealant, complying with:
         1) FS TT-S-00227E, Type II, Class A; ASTM C920, Type M, Grade NS, Class 25.
         2) Adhesion-in-Peel, FS TT-S-00227E, ASTM C794 (Minimum five pounds per linear inch with no adhesion failure): 18 pounds.
         3) Hardness (Standard Conditions), ASTM C661: 25 (Shore A).
         4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
         5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
         6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
         7) VOC Content: 220 g/L, maximum.
         8) Listed in NSF/ANSI 61

B. Exterior and Interior Horizontal and Vertical Joints; Submerged and Intermittently Submerged in Wastewater:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c NS by Sika Corporation.
         2) Vulkem 227 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
         3) Or equal.
      b. Polyurethane based, two-component elastomeric sealant complying with:
         1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
         2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 18 lbs.
         3) Hardness (Standard Conditions), ASTM C661: 25 (Shore A).
         4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
         5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
         6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
         7) VOC Content: 220 grams per liter, maximum.

C. Exterior and Interior Vertical Joints; Non-submerged:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c NS by Sika Corporation.
         2) Dymeric 240 FC by Tremco Sealant/Waterproofing Division of RPM International, Inc.

3) Or equal.

b. Polyurethane based, two-component elastomeric sealant complying with:
   1) FS TT-S-00227E: Type II (non-sag) Class A and ASTM C920, Type M, Grade NS, Class 25.
   2) Adhesion-in-Peel, FS TT-S-00227E and ASTM C794: (Minimum five pounds per linear inch with no adhesion failure): 10 pounds.
   3) Hardness (Standard Conditions), ASTM C661: 25 to 35 (Shore A).
   4) Stain and color change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
   5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
   6) Rheological Vertical Displacement at 120 degrees F, FS TT-S-00227E: No sag.
   7) VOC Content: 100 g/L, maximum.

D. Exterior and Interior Horizontal Joints; Non-submerged:
   1. Two-component Polyurethane Sealant:
      a. Products and Manufacturers: Provide one of the following:
         1) Sikaflex- 2c SL by Sika Corporation.
         2) THC/900 by Tremco Sealant/Waterproofing Division of RPM International, Inc.
         3) Or equal.
      b. Polyurethane based, two-component elastomeric, self-leveling sealant complying with the following:
         1) FS TT-S-00227E, Type I (self-leveling) Class A. and ASTM C920, Type M, Grade P, Class 25
         2) Water Immersion Bond, FS TT-S-00227E: Elongation of 50 percent with no adhesive failure.
         3) Hardness (Standard Conditions), ASTM C661: 35 to 45.
         4) Stain and Color Change, FS TT-S-00227E and ASTM C510: No discoloration or stain.
         5) Accelerated Aging, ASTM C793: No change in sealant characteristics after 250 hours in weatherometer.
         6) VOC Content: 165 g/L, maximum.

E. Miscellaneous Materials:
   1. Joint Cleaner: As recommended by calking and sealant manufacturer.
   2. Joint Primer and Sealer: As recommended for compatibility with calking and sealant by calking and sealant manufacturer.
   3. Bond Breaker Type: Polyethylene tape or other plastic tape as recommended for compatibility with calking and sealant by calking and sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of calking and sealant. Provide self-adhesive tape where applicable.
   4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable nonabsorptive material as recommended for compatibility with calking and sealant by calking and sealant manufacturer. Provide size and shape of rod that will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide highly-compressible backer to minimize possibility of sealant extrusion when joint is compressed.
   5. Low-temperature Catalyst: As recommended by calking and sealant manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine joint surfaces, substrates, backing, and anchorage of units forming sealant rabbet, and conditions under which calking and sealant Work will be performed, and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work and performance of sealants. Do not proceed with calking and sealant Work until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Protection: Do not allow joint sealants to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough textured materials. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or calking and sealant materials.

B. Joint Surface Preparation:
   1. Clean joint surfaces immediately before installing sealant compound. Remove dirt, weakly adhering coatings, moisture and other substances that would interfere with bonds of sealant compound as recommended in sealant manufacturer's written instructions as shown on approved Shop Drawings.
   2. If necessary, clean porous materials by grinding, sandblasting, or mechanical abrading. Blow out joints with oil-free compressed air or by vacuuming joints prior to applying primer or sealant.
   3. Roughen joint surfaces on vitreous coated and similar non-porous materials, when sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce a dull sheen.
   4. Concrete Joint Preparation: Refer to Section 03 00 05, Concrete.

C. Mixing:
   1. Comply with sealant manufacturer's written instructions for mixing multi-component sealants.
   2. Thoroughly mix components before use.
   3. Add entire contents of activator can to base container. Do not mix partial units.
   4. Mix contents for minimum of five minutes or as recommended by sealant manufacturer, until color and consistency are uniform.

3.3 INSTALLATION

A. Install joint sealants after adjacent areas have been cleaned and before joint has been cleaned and primed, to ensure calking and sealant joints will not be soiled. Replace calking and sealant joints soiled after installation.

B. Comply with sealant manufacturer's written instructions except where more stringent requirements are shown or indicated in the Contract Documents.

C. Prime or seal joint surfaces as shown on approved Shop Drawings and approved other submittals. Do not allow primer or sealer to spill or migrate onto adjoining surfaces. Allow primer to dry prior to applying sealants.

D. Apply masking tape before installing primer, in continuous strips in alignment with joint edge to produce sharp, clean interface with adjoining materials. Remove tape immediately after joints have been sealed and tooled as directed.

E. Confirm that compressible filler is installed before installing sealants.

F. Do not install sealants without backer rods and bond breaker tape.

G. Roll back-up rod stock into joint to avoid lengthwise stretching. Do not twist, braid, puncture, or prime backer rods.

H. Employ only proven installation techniques that will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

I. Install sealants to depths recommended by sealant manufacturer but within the following general limitations, measured at the center (thin) section of bead.
   1. For horizontal joints in sidewalks, pavements, and similar locations sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8-inch deep or less than 3/8-inch deep.
   2. For vertical joints subjected to normal movement and sealed with elastomeric sealants and not subject to traffic, fill joints to a depth equal to 50 percent of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.

J. Remove excess and spillage of compounds promptly as the Work progresses.

K. Cure calking and sealant compounds in compliance with manufacturer's instructions and recommendations, to obtain high-early bond strength, internal cohesive strength, and surface durability.

3.4 EXISTING JOINTS

A. Mechanically remove existing sealant and backer rod.

B. Clean joint surfaces of residual sealant and other contaminates capable of affecting sealant bond to joint surface.

C. Conduct laboratory pre-construction compatibility and adhesion testing on joint surfaces in accordance with Part 3 of this Section.

D. Allow joint surfaces to dry before installing new sealants.

3.5 FIELD QUALITY CONTROL

A. Water Leak Testing: Field test for water leaks as follows:
   1. Flood the joint exposure with water directed from a 3/4-inch diameter garden hose, without nozzle, held perpendicular to wall face, two feet from joint and connected to water system

with 30 psi minimum normal water pressure. Move stream of water along joint at an approximate rate of 20 feet per minute.

2. Test approximately five percent of total joint system, in locations that are typical of every joint condition, and that can be inspected easily for leakage on opposite face. Conduct test in presence of ENGINEER, who will determine actual percentage of joints to be tested and actual period of exposure to water from hose, based on extent of observed leakage or lack of observed leakage.
3. Where nature of observed leaks indicates potential of inadequate joint bond strength, ENGINEER may direct that additional testing be performed at a time when joints are fully cured, and before Substantial Completion.

3.6 ADJUSTING AND CLEANING

A. Where leaks and lack of adhesion are evident, replace sealant.

B. Clean adjacent surfaces of sealant and soiling resulting from the Work. Use solvent or cleaning agent recommended by sealant manufacturer. Leave all finish Work in neat, clean condition.

C. Protect sealants during construction so that they will be without deterioration, soiling, or damage at time of readiness for final payment of the Contract.

3.7 PROTECTION

A. During and after curing period, protect joint sealants from contact with contaminating substances and from damage resulting from construction operations or other causes, so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original Work.

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals required to perform clearing and grubbing as shown and specified in the Contract Documents.
   2. The Work includes removing from the Site and disposing of trees, stumps, brush, roots, shrubs, vegetation, logs, rubbish, and other objectionable material.
   3. Pay all costs associated with transporting and disposing of debris resulting from clearing.
   4. Limits of Clearing and Grubbing: Clear and grub the areas shown or indicated on the Drawings.

B. Related Sections and Details:
   1. Section 02 41 00, Demolition.
   2. York County Engineering Standards 16-series Standard Details.

1.2 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with Laws and regulations for environmental requirements, disposal of debris, burning debris on Site, and use of herbicides.
   2. Coordinate clearing work with York County and other authorities having jurisdiction, including Utility providers.

1.3 SUBMITTALS

A. Action Submittals: Submit the following
   1. Shop Drawings:
      a. Plan for removing trees and other large vegetation not explicitly shown or indicated for removal in the Contract Documents.
      b. Plan showing proposed limits of clearing and grubbing, if different from clearing and grubbing limits shown or indicated in the Contract Documents.

1.4 WARRANTY

A. CONTRACTOR shall warrant that Work performed under this Section will not permanently damage trees, shrubs, turf, and plants designated to remain, or other adjacent work, facilities, or property. If damage resulting from CONTRACTOR's operations becomes evident during the correction period, CONTRACTOR shall replace damaged items and property at no additional cost to OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PREPARATION

A. Protection:
   1. Throughout the Project, protect existing site improvements, including streets, drives, and Underground Facilities to remain (if any), and adjacent property and structures. Repair damage caused by CONTRACTOR to original condition or replace in kind, to satisfaction of ENGINEER, at no additional cost to OWNER.
   2. Protect trees, shrubs, vegetation, and grassed areas to remain by providing temporary fencing, barricades, wrapping, or other methods shown, specified, or accepted by ENGINEER. Correct at CONTRACTOR's expense damage caused by CONTRACTOR outside the limits of clearing Work.
   3. Do not remove trees without approval of ENGINEER, unless shown or indicated for removal.
   4. Do not locate construction equipment, stored materials, or stockpiles within drip line of trees and vegetation to remain.

B. Site Preparation:
   1. Obtain, pay costs associated with, and comply with applicable permits required for clearing and grubbing Work. Do not begin clearing and grubbing Work to acquiring all applicable permits.
   2. Delineation of Clearing and Grubbing Limits:
      a. Locate and clearly flag trees and vegetation to remain, and other materials to remain in the clearing and grubbing limits. Locate and clearly flag salvable vegetation to be relocated.
      b. Provide flagging to delineate limits of areas to be cleared or grubbed. Review at Site with ENGINEER before commencing removal of trees, vegetation, and other materials to be removed.
      c. Replace flagging that is lost, removed, or destroyed, until clearing and grubbing Work is complete and ENGINEER allows removal of flagging.
   3. Erosion and Sediment Controls:
      a. Provide applicable erosion and sediment controls before commencing clearing and grubbing Work.
      b. Comply with York County Engineering Standards 16-series Standard Details and related Standard Details and erosion control requirements and rules and regulations.
      c. Continue providing erosion and sediment controls as clearing and grubbing Work progresses to previously uncleared, ungrubbed areas of the Site.

3.2 CLEARING AND GRUBBING

A. Clearing and grubbing shall be performed along the project at the locations designated on the drawings or as directed by the Engineer.

B. Conduct operations in a manner so as to prevent limb, bark, or root injuries to trees, shrubs, or other types of vegetation that are to remain growing and also to prevent damage to adjacent property.

C. Exercise extreme caution in order not to clear and grub areas outside of the construction right-of-way.

D. Remove and dispose of all trees not reserved by the property owner, shrubs, stumps, roots, brush, tree laps, logs, rubbish, undergrowth, and debris within limits of clearing and grubbing shown or indicated in the Contract Documents, unless otherwise shown or indicated.

E. Any areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes will be designated on the drawings or by the ENGINEER.

F. Maintenance of cleared and grubbed areas include:
   1. Clean-up of overgrown areas.
   2. Continuous weeding, brush cutting, and pruning for all areas within the contract site that has been cleared and/or grubbed. This shall take place from the Notice to Proceed until the final approval of the contract. This work is to be accomplished regardless of the phase of work in progress or any delays caused by weather, utilities, or property acquisitions.
   3. CONTRACTOR is to provide for bush-hogging or weed-eating certain areas within the public access or easements that have become overgrown as directed by the ENGINEER. This includes any staging areas being used by the CONTRACTOR for the duration of the contract.

G. Trees and Shrubs Improperly Destroyed or Damaged:
   1. For each tree or shrub to remain that is destroyed or damaged beyond repair by CONTRACTOR, provide two replacements of the same species at locations to be designated by ENGINEER.

H. Trees and shrubs to remain that have been damaged or require trimming shall be protected, treated and repaired under the direction of a qualified arborist, or other professional with qualifications acceptable to ENGINEER.

I. Salvable Vegetation:
   1. Trees, shrubs, and other vegetation requiring removal to facilitate the Work, and that will be transplanted elsewhere at the Site, shall be carefully balled and burlapped or placed in temporary pots, and stored at the Site in an acceptable area. Work involving removing and relocating trees, shrubs, and other vegetation shall be under the direction of qualified arborist acceptable to ENGINEER, or other professional acceptable to ENGINEER, hired by CONTRACTOR.

J. Disposal of Cleared and Grubbed Materials:
   1. Dispose at appropriate off-Site location trees, stumps, rubbish, debris, and other cleared and grubbed material. Cleared or grubbed materials may remain at the Site only when allowed in the Contract Documents or when approved by ENGINEER in writing. Do not use cleared or grubbed material as fill, backfill, or in embankments.
   2. Dispose of cleared and grubbed material in accordance with Laws and Regulations.
   3. Do not burn clearing debris at the Site, unless approved by OWNER and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities

having jurisdiction and Laws and Regulations. If burning is permitted at the Site, also comply with OWNER's requirements.

K. Removal of Site Improvements: Comply with Section 02 41 00, Demolition.

3.3 TOPSOIL REMOVAL

A. Existing topsoil to be removed is defined as friable, clay loam, surface soil present in depth of at least four inches. Topsoil shall be free of subsoil, clay lumps, stones, and other objects over two-inch diameter and other objectionable material.

B. Stripping:
   1. Strip topsoil to depths encountered, in manner that prevents intermingling of topsoil with underlying subsoil or other objectionable material. Remove heavy growths of grass and vegetation from areas before stripping.
   2. Do not strip topsoil from within drip line of each tree to remain as part of the completed Project.

C. Stockpile topsoil in storage stockpiles in areas shown, or where otherwise accepted by ENGINEER. Construct storage piles so that surface water drains freely. Stabilize large topsoil piles with a cover crop and mulch, and provide silt fencing around perimeter of pile to prevent topsoil erosion and sedimentation; silt fencing shall be in accordance with York County Engineering Standard Details 16.03 and 16.03A and rules and regulations. Cover smaller topsoil stockpiles, when used, with reinforced fabric to prevent windblown dust. Topsoil in excess of the quantity required for the finished Project shall remain property of OWNER.

3.4 ENVIRONMENTAL PROTECTION AND RESTORATION

A. South Carolina Department of Health and Environmental Control.

B. South Carolina Department of Natural Resources.

C. US Army Corps of Engineers.

D. US Department of the Interior.

E. York County Environmental Compliance or local Authority Having Jurisdiction.

END OF SECTION

SECTION 31 23 05

EXCAVATION AND FILL

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to perform all excavating, filling, and grading, and disposing of earth materials as shown, specified, and required for construction of structures, Underground Facilities, roads, and other facilities required to complete the Work.
   2. Preparation of subgrade for slabs and pavements is included under this Section.
   3. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof, except rock requiring drilling, blasting or special equipment for removal which is under Section 31 23 16.26, Rock Removal.

B. Related Sections:
   1. Section 03 30 05, Concrete.
   2. Section 31 23 16.26, Rock Removal.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ACI 522R, Pervious Concrete.
   2. ANSI/AISC 360, Specification for Structural Steel for Buildings.
   3. ASTM C29/C29M, Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate.
   4. ASTM C33/C33M, Specification for Concrete Aggregates.
   5. ASTM C94/C94M, Specification for Ready-Mixed Concrete.
   6. ASTM C138/C138M, Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   7. ASTM C172, Practice for Sampling Freshly Mixed Concrete.
   8. ASTM C150/C150M, Specification for Portland Cement.
   9. ASTM C595/C595M, Specification for Blended Hydraulic Cements.
   10. ASTM C618, Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   11. ASTM C989, Specification for Slag Cement for Use in Concrete and Mortars.
   12. ASTM D422, Test Method for Particle-Size Analysis of Soils.
   13. ASTM D448, Classification for Sizes of Aggregate for Road and Bridge Construction.
   14. ASTM D698, Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).
   15. ASTM D1556, Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   16. ASTM D1557, Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   17. ASTM D2216, Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.

18. ASTM D4253, Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
19. ASTM D4254, Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
20. ASTM D4318, Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
21. ASTM D4832, Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
22. ASTM D6023, Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM).
23. ASTM D6103, Test Method for Flow Consistency of Controlled Low Strength Material (CLSM).
24. ASTM D6938, Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
25. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
26. South Carolina Department of Transportation Qualified Products Listings and Policies for Construction and Maintenance Materials.
27. Work Area Traffic Control Handbook (WATCH).
28. York County Ordinance 154.110.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Subgrade” is the uppermost surface of native soil material unmoved from cuts; the bottom of excavation.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Professional Engineer:
      a. Engage a registered professional engineer legally qualified to practice in the same jurisdiction as the Site and experienced in providing engineering services of the kind indicated.
      b. Responsibilities include but are not necessarily limited to:
         1) Reviewing system performance and requirements shown or indicated in the Contract Documents.
         2) Preparing written requests for clarifications or interpretations of performance and requirements for submittal to ENGINEER by CONTRACTOR.
         3) Preparing or supervising the preparation of design calculations and related submittals verifying compliance of the system with the requirements of the Contract Documents.
         4) Signing and sealing all calculations, drawings, and submittals prepared by professional engineer.
         5) Certifying that:
            a) it has performed the design of the system in accordance with the performance requirements stated in the Contract Documents, and
            b) the said design conforms to Laws and Regulations, and to the prevailing standards of practice.

B. Quality Assurance Testing:
   1. OWNER typically retains 3rd party for Quality Control testing on capital projects. Specific Quality Assurance Testing requirements and procedures shall be established on a Project-by-Project basis.
   2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests, including retesting of rejected materials and installed Work, shall be performed by OWNER and at OWNER'S expense.

C. Regulatory Requirements:
   1. Perform excavation work in compliance with requirements of authorities having jurisdiction and Laws and Regulations, including:
      a. OSHA, 29 CFR Part 1926, Section .650 (Subpart P – Excavations).
   2. Obtain required permits and approvals for excavation and fill Work, including work permits from right-of-way owners and permits from environmental authorities having jurisdiction over discharge of water from excavations.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Procedure Submittals:
      a. Excavation Plan: Prior to starting excavation operations, submit written plan to demonstrate compliance with OSHA 29 CFR Part 1926.650. As a minimum, excavation plan shall include:
         1) Name of CONTRACTOR's "competent person" in responsible charge of excavation and fill Work.
         2) Excavation method(s) and additional items to be included in the Work, as listed in Paragraph 1.5.A.2.a of this Section.
         3) Copies of "manufacturer's data" or other tabulated data if protective system(s) are designed on the basis of such data.
         4) Copies of required permits and approvals, from authorities having jurisdiction and affected utility owners, for excavation methods proposed.
      b. Proposed compaction procedure and compaction equipment proposed for use. Where different procedures or equipment will be used for compacting different types of material or at different locations at the Site, indicate where each procedure and equipment item will be used.
   2. Excavation Support Plan and Related Information Prepared by CONTRACTOR's Professional Engineer:
      a. CONTRACTOR and CONTRACTOR's professional engineer shall prepare the following for submittal:
         1) Sheeting and bracing, or other protective system(s) required.
         2) Dewatering system.
         3) Cofferdams.
         4) Underpinning.
      b. Drawings and calculations shall be prepared by professional engineer qualified in the specialty involved. ENGINEER's review and acceptance of submittal does not imply approval by ENGINEER of the associated Work. CONTRACTOR shall be solely responsible for designing, installing, operating and maintaining the system(s) required to satisfactorily perform all necessary sheeting, bracing, protection, underpinning, and dewatering.

3. Delivery Tickets:
    a. Copy of delivery ticket for each load of aggregate and borrow material delivered to the Site. Each delivery ticket shall indicate project and contract by name and number, date, material type, department of transportation item number when applicable, and quantity delivered.
4. Quality Assurance Test Results Submittals:
    a. Submit results of quality assurance testing performed by in accordance with Paragraph 1.4.B of this Section, unless included as part of another submittal under this Section. Submit results for the following quality assurance testing:
        1) Tests on borrow fill material.
        2) Optimum moisture – maximum dry density curve for each type of fill material.
5. Qualifications Statements:
    a. Professional engineer.

1.6 SITE CONDITIONS

A. Subsurface Information: The Project Manual indicates information available relative to subsurface conditions at the Site. Such information and data is not intended as a representation or warranty of continuity of conditions between soil borings or test pits, nor of groundwater levels at dates and times other than date and time when measured, nor that purpose of obtaining the information and data were appropriate for use by CONTRACTOR. OWNER will not be responsible for interpretations or conclusions drawn therefrom by CONTRACTOR.

B. Soil borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to OWNER. Coordinate CONTRACTOR-performed test borings and other exploratory operations with OWNER and utility owners as appropriate. Perform such explorations without disrupting or otherwise adversely affecting operations of OWNER or utility owners. Comply with Laws and Regulations relative to required notifications.

C. Existing Structures:
1. The Contract Documents show or indicate certain structures and Underground Facilities adjacent to the Work. Such information was obtained from existing records and is not guaranteed to be correct or complete. CONTRACTOR shall explore ahead of the excavation to determine the exact location of all existing structures and Underground Facilities. Existing structures and Underground Facilities shall be supported and protected from damage by CONTRACTOR. Immediately repair and restore existing structures and Underground Facilities damaged by CONTRACTOR without additional cost to OWNER.
2. Movement or operation of construction equipment over Underground Facilities shall be at CONTRACTOR's sole risk and only after CONTRACTOR has prepared and submitted to ENGINEER and utility owners (as applicable), and received acceptance therefrom, a plan describing CONTRACTOR's analysis of the loads to be imparted and CONTRACTOR's proposed measures to protect structures and Underground Facilities during the Project.
3. Coordinate with utility owners for shut-off of services in active piping and conduits. When required by utility owner, OWNER will assist CONTRACTOR with utility owner notifications. Completely remove buried piping and conduits indicated for removal and not otherwise indicated as being abandoned or to remain in place.

4. In general, service lines and laterals to individual houses and businesses are not shown; however, CONTRACTOR shall assume that a service exists for each utility owner to each house, business, and property.
5. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when such interruption is indicated in the Contract Documents or when allowed in writing by ENGINEER after acceptable temporary utility services are provided by CONTRACTOR for the affected structure or property.

PART 2 PRODUCTS

2.1 MATERIALS

A. Select Fill:
   1. Material shall be well-graded, crushed aggregate, free of organic material. Material shall be Coarse Aggregate No. 57 in accordance with the Coarse Aggregate Gradation Table in the appendix of the SCDOT Standard Specifications for Highway Construction.

B. General Fill:
   1. Material shall be free of: roots, vegetative matter, waste, construction material, rock larger than ¾ cubic foot, debris, waste, frozen materials, organic material, and other deleterious matter. Small rock shall not exceed 10% of the fill material.
   2. Fill shall have a liquid limit not greater than 45, and plasticity index not greater than 25, or as directed by ENGINEER.
   3. Previously-excavated materials complying with the Contract Documents requirements for general fill may be used for general fill.
   4. When on-Site materials are found unsuitable for use as general fill, provide select fill or approved off-Site general fill materials. Prior to using off-Site material as general fill, furnish submittal for and obtain ENGINEER's approval of the material proposed for use.

C. Subbase Material:
   1. Material shall be naturally- or artificially-graded mixture of natural or crushed gravel or crushed stone. Crushed slag is unacceptable. Material shall be coarse aggregate obtained from sources listed on the most recent edition of SCDOT Qualified Products List 2.
   2. Crushed Recycled Concrete Subbase Material:
      a. CONTRACTOR may use crushed recycled concrete material as subbase material.
      b. Recycled concrete material shall be crushed and screened and shall comply with subbase gradation requirements of this Section. Before using in the Work, remove existing reinforcing steel from recycled concrete material.
      c. Crushed recycled concrete material shall not contain chloride ions or aggregates susceptible to alkali-silica reaction.
      d. The pH of recycled concrete material shall not exceed 11.

D. Drainage Fill:

1. Material shall be washed, uniformly-graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing 1.5-inch sieve and not more than five percent passing a No. 4 sieve.

E. Pipe Bedding Material:
   1. Aggregate material shall be angular, clean washed, crushed stone and gravel, free of: debris, waste, frozen materials, organic material and other deleterious matter. Material shall be Size No. 67 (or, No. 57, for sewer lines) in accordance with ASTM D448 and South Carolina Department of Transportation Standard Specifications.

F. Stone Stabilization Material:
   1. Stone stabilization material shall be angular, clean washed No. 67 stone in accordance with ASTM D448.

2.2 SOURCE QUALITY CONTROL

A. Perform quality assurance testing, and submit results to ENGINEER, in accordance with the 'Quality Assurance" Article in Part 1 of this Section.

PART 3 EXECUTION

3.1 INSPECTION

A. Provide ENGINEER with sufficient notice and with means to examine areas and conditions under which excavating, filling, and grading will be performed. ENGINEER will advise CONTRACTOR in writing when ENGINEER is aware of conditions that may be detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.2 TEST PITS

A. General:
   1. In advance of the construction, excavate, make observations and measurements, and fill test pits to determine conditions or location of the existing Underground Facilities and structures. Perform all work required in connection with excavating, stockpiling, maintaining, sheeting, shoring, filling, and replacing pavement for test pits. CONTRACTOR shall be responsible for the definite location of each existing Underground Facility involved within the area of excavation for the Work. Exercise care during such location work to avoid damaging and disrupting the affected Underground Facility or structure. CONTRACTOR shall be responsible for repairing, at his expense, damage to Underground Facility or structure caused during the Work.

3.3 PREPARATION

A. Do not burn clearing debris at the Site unless approved by OWNER and authorities having jurisdiction. If burning is permitted, comply with requirements of authorities having jurisdiction and Laws and Regulations. If burning is permitted at the Site, also comply with OWNER's requirements.

B. Use of Explosives:
   1. Do not bring explosives to the Site or use explosives without written consent of OWNER and authorities having jurisdiction. Obtaining such written consent will not relieve CONTRACTOR of responsibility for injury or damage caused by CONTRACTOR's blasting operations. Submit to ENGINEER copies of written consent and permits for blasting. When permitted, blasting shall comply with Section 31 23 16.26, Rock Removal. CONTRACTOR is solely responsible for handling, storing, and using explosive materials when use of explosives is permitted.

C. Dust Control:
   1. Control objectionable dust caused by CONTRACTOR's operation of vehicles and equipment, clearing, and other actions. To minimize airborne dust, apply water or use other methods subject to ENGINEER's acceptance and approval of authorities having jurisdiction.

D. Maintenance and Protection of Traffic:
   1. Maintain traffic in accordance with the most recent edition of the Watch Area Traffic Control Handbook.

3.4 DEWATERING

A. Dewatering – General:
   1. Provide and maintain adequate drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work and work areas. Keep each excavation dry during excavation, subgrade preparation, and continually thereafter until the structure to be built therein is acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
   2. Keep all working areas at the Site free of surface water at all times. Provide temporary drainage ditches and temporary dikes, and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
   3. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.
   4. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.
   5. Remove water from excavations as fast as water collects.

B. Temporary Dewatering System:
   1. CONTRACTOR shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level 1'-0" below the base of each excavation during all stages of construction operations.

2. Design and operate dewatering system to avoid settlement and damage to existing structures and Underground Facilities.
3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.
4. Maintain groundwater level at excavations two feet below lowest subgrade excavation until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.
5. Operate dewatering system continuously, 24 hours per day, seven days per week. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining ENGINEER's acceptance for such discontinuation.
6. If, in ENGINEER's opinion, the water levels are not being lowered or maintained as required, provide additional or alternate temporary dewatering devices as necessary, at no additional cost to OWNER.
7. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
8. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain ENGINEER's acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until waterproofing Work is completed.
9. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.
10. Before discontinuing dewatering operations or permanently allowing rise of groundwater level, prepare computations to demonstrate that structures affected by the water level rise are protected by fill or other means to sustain uplift. Use a safety factor of 1.25 when preparing such calculations.

C. Disposal of Water Removed by Dewatering System:
1. CONTRACTOR's dewatering system shall discharge to a suitable location acceptable to OWNER, in accordance with Laws and Regulations.
2. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
3. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
4. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.5 EXCAVATION

A. Perform all excavation required to complete the Work as shown, specified, and required. Excavations shall include removing and handling of earth, sand, clay, gravel, hardpan, soft, weathered or decomposed rock, pavements, rubbish, and other materials within the excavation limits. Where the excavation includes rock that requires drilling, blasting, or specialized equipment for removal, remove rock in accordance with Section 31 23 16.26, Rock Removal.

B. Excavation Protection:

1. Provide excavation protection system(s) in accordance with Laws and Regulations to prevent injury to persons and property, including Underground Facilities.
2. Excavation Less Than Five Feet Deep: Excavations in stable rock or in soil conditions where there is no potential for a cave-in may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
3. Excavations Greater Than Five Feet Deep: Excavations in stable rock may be made with vertical sides. Under all other conditions, excavations shall be sloped and benched, shielded, or shored and braced.
4. Provide and maintain excavation protection system(s) in accordance with submittals accepted by ENGINEER and required under Paragraph 1.5 of this Section.

C. Maintain excavations in dry condition in accordance with “Dewatering” Article in Part 3 of this Section.

D. Elevation of bottom of footings shown is approximate. ENGINEER may direct such minor changes in dimensions and elevations as may be required to secure a satisfactory footing.

E. When excavations are made below required grades without written order of ENGINEER, fill such excavations with compacted select fill material, as directed by ENGINEER, at CONTRACTOR’s expense.

F. Extend excavations sufficiently on each side of structures, footings, and similar construction to allow setting of forms, installation of shoring and bracing, and the safe sloping of banks, as necessary.

G. Subgrades – General:
1. Subgrades shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades that are otherwise solid but become soft or mucky on top due to construction operations shall be reinforced with course aggregate material obtained from sources listed on the most recent edition of SCDOT Qualified Products List 2. Finished elevation of stabilized subgrades shall not be above subgrade elevations shown.
2. If, in ENGINEER’s opinion, subgrade becomes softened or mucky because of construction delays, failure to dewater properly, or other cause within CONTRACTOR’s control, subgrade shall be excavated to firm material, trimmed, and backfilled with select fill material at CONTRACTOR’s expense.

H. Proofrolling Subgrades:
1. Prior to placing fill or constructing pavements or slabs, proofroll the subgrade surface with sufficient proofrolling apparatus. Before starting proofrolling, submit to and obtain acceptance from ENGINEER of proofrolling apparatus and procedure to be used.
2. Proofrolling operations shall be made in the presence of ENGINEER. Notify ENGINEER at least 24 hours in advance of start of proofrolling operations.
3. Subgrades displaying pronounced elasticity or deformation, deflection, cracking, or rutting shall be stabilized as directed by ENGINEER. Unsuitable materials shall be undercut to the depth directed by ENGINEER and replaced with select fill material. Other suitable stabilization methods may be directed by ENGINEER.

I. Pipe Trench Preparation:
   1. Not more than 100 feet of trench may be opened in advance of installing pipe in trench unless prior approval is given by the ENGINEER.
   2. Trench width shall be minimized to greatest extent practical, and shall comply with the following:
      a. Trench width shall be sufficient to provide space for installing, jointing and inspecting piping. Refer to Drawings for trench requirements.
      b. Waterlines:
         1) Maximum allowable trench width at the top of pipe shall be equal to the pipe barrel OD plus sixteen inches, unless otherwise shown or indicated.
         2) Prior approval of County Inspector is required to deviate from this; if no prior approval is received, bedding shall be installed per ENGINEER's direction and at Contractor's expense.
      c. Sewer lines: Maximum allowable trench width at the top of pipe shall be:
         1) For 8"-15" pipe, the maximum trench width at the top of pipe shall be nominal pipe size plus 30 inches.
         2) For 18"-30" pipe, the maximum trench width at the top of pipe shall be nominal pipe size plus 36 inches.
         3) For 36" and larger pipe, the maximum trench width at the top of pipe shall be nominal pipe size plus 42 inches.
         4) Prior approval of ENGINEER is required to deviate from maximum allowable widths. Such deviation requiring an increase in bedding and/or change in pipe class will be installed at Contractor's expense.
      d. Trench width shall be sufficient for shoring and bracing, or shielding and dewatering.
      e. Do not use excavating equipment that requires the trench to be excavated to excessive width.
   3. Depth of trench shall be as shown or indicated. If required and approved by ENGINEER in writing, depths may be revised.
   4. Where ENGINEER considers existing material beneath bedding material unsuitable, remove and replace such unsuitable material with select fill material.

J. Excavated Materials to be Used as Fill:
   1. Stockpile excavated materials that are acceptable for use as fill.
   2. As excavation proceeds, keep stockpiles of excavated materials suitable for use as fill separate from unsuitable materials and waste materials.
   3. Place, grade, and shape stockpiles for proper drainage.
   4. Locate and retain soil materials away from edge of excavations.
   5. Dispose of excess soil material and waste materials as specified in this Section.
   6. Stockpiled excavated soils for use as select fill or general fill shall be tested and classified by laboratory as on-Site select fill or on-Site general fill. Perform required quality assurance testing for material verification on stockpiled materials as soon as possible to demonstrate compliance of excavated materials with the Contract Documents.

3.6 UNAUTHORIZED EXCAVATION

A. All excavations outside lines and grades shown or indicated and that are not approved by ENGINEER, together with removing and disposing of the associated material, shall be at

CONTRACTOR's expense. Fill unauthorized excavations with properly-compacted select fill material at CONTRACTOR's expense.

3.7 EROSION AND SEDIMENT CONTROLS

A. Provide temporary erosion and sediment controls in accordance with York County Engineering Standards 16-series Standard Details and related Standard Details and erosion control requirements. When applicable, also comply with requirements of the erosion and sediment control plan approved by authorities having jurisdiction.

3.8 SHEETING, SHORING, AND BRACING

A. General:
   1. Design and provide sheeting, shoring, bracing, cofferdams, and similar excavation supports as shown, specified, and required for the Work.
   2. Clearances and types of temporary sheeting, shoring, bracing, and similar excavation supports, insofar as they may affect the finished character of the Work and the design of sheeting to be left in place, will be subject to the ENGINEER's approval; but CONTRACTOR is responsible for adequacy of all sheeting, shoring, bracing, cofferdams, and similar excavation supports.
   3. Materials:
      a. Previously-used materials shall be in good condition, and shall not be damaged or excessively pitted. All steel or wood sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary sheeting, shoring, and bracing.
      b. All steel work for sheeting, shoring, bracing, cofferdams and other excavation supports, shall be in accordance with ANSI/AISC 360, except that field welding will be allowed.
      c. Provide permanent steel sheet piling or pressure-creosoted timber sheet piling where subsequent removal of sheet piling might allow lateral movement of soil under adjacent structures
   4. As excavation progresses, carry down shoring, bracing, cofferdams, and similar excavation supports to required elevation at bottom of excavation.
   5. Comply with Laws and Regulations regarding sheeting, shoring, bracing, cofferdams, and similar excavation supports.
   6. Maintain sheeting, shoring, bracing, bracing, and other excavation supports in excavations regardless of time period excavations will be open.
   7. Unless otherwise shown, specified, or directed, remove materials used for temporary construction when the Work is completed. Perform such removal in manner not injurious to the structures and Underground Facility, their appearance, and adjacent construction.

B. Sheeting Left in Place:
   1. Materials: Steel sheeting shown or indicated to be left in place shall consist of rolled sections of continuous interlocking type. Steel sheeting material designated to be left in place shall be new. Type and design of the sheeting and bracing shall comply with the above requirements for steel work for all sheeting and bracing.
   2. Installation:
      a. Steel sheeting to be left in place shall be driven straight to lines and grades as shown, indicated, or directed. Piles shall penetrate into firm materials with secure

interlocking throughout pile's entire length. Damaged piling having faulty alignment shall be pulled and replaced by new piling.

b. Type of guide structure used and method of driving steel sheeting to be left in place shall be determined by CONTRACTOR's professional engineer. Jetting is not allowed.

3. Cut off at elevations shown, indicated, or directed by ENGINEER sheeting left in place and remove cut off pilings from the Site.
4. Clean wales, braces, and all other items to be embedded in the permanent structure, and ensure that concrete surrounding the embedded element is sound and free of air pockets and harmful inclusions. Provisions shall include the cutting of holes in the webs and flanges of wale and bracing members, and welding of steel diaphragm waterstops perpendicular to the centerline of brace ends that are to be embedded.
5. Subsequent to removing the inside face forms, and when removal of bracing is allowed, cut back steel at least two inches inside the wall face and patch opening with concrete repair mortar in accordance with Section 03 00 05, Concrete. Concrete shall be thoroughly worked beneath wales and braces, around stiffeners, and at other place where voids may be formed.
6. Portions of sheeting or soldier piles and breast boards that are in contact with structure foundation concrete shall be left in place, together with wales and bracing members that are cast into foundation or superstructure concrete.

C. Removal of Sheeting and Bracing:
1. Remove sheeting and bracing from excavations, unless otherwise directed by ENGINEER in writing. Perform removal to avoid damaging the Work and adjacent construction. Removal shall be equal on both sides of excavation to ensure no unequal loads on structures and Underground Facilities.
2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete, until the following conditions are satisfied:
   a. Concrete has cured for not less than seven days.
   b. Wall and floor framing, up to and including grade level floors, is in place.

3.9 TRENCH SHIELDS

A. Excavation of earth material below bottom of trench shield shall not exceed the limits established in Laws and Regulations.

B. When using a shield for installing piping:
1. Portions of trench shield extending below the mid-diameter of an installed, rigid pipe, such as prestressed concrete pipe and other types of rigid pipe, shall be raised above the pipe's mid-diameter elevation prior to moving the shield along the trench for further construction.
2. Bottom of shield shall not at any time extend below mid-diameter of installed pipe that is flexible or has flexing capability, such as steel, ductile iron, PVC, CPVC, polyethylene, and other pipe that has flexing capability.

C. When using a shield for installing structures, bottom of the shield shall not extend below the top of the bedding for the structures.

D. When removing the shield or moving the shield ahead, exercise extreme care to prevent moving piping, structures, and other Underground Facilities, and prevent disturbance of

bedding material for piping, structures, and other Underground Facilities. When piping, structures, or Underground Facilities are disturbed, remove and reinstall the disturbed items in accordance with the Contract Documents.

3.10 FILL AND COMPACTION – GENERAL PROVISIONS

A. Provide and compact all fill required for the finished grades as shown and as specified in this Section.

B. Place fill in excavations as promptly as progress of the Work allows, but not until completing the following:
   1. ENGINEER's authorization after observation of construction below finish grade, including dampproofing, waterproofing, perimeter insulation, and similar Work.
   2. Inspection, testing, approval, and recording of locations of Underground Facilities.
   3. Removal of concrete formwork.
   4. Removal of shoring and bracing, and filling of voids with satisfactory materials.
   5. Removal of trash and debris.
   6. Permanent or temporary horizontal bracing is in place on horizontally-supported walls.
   7. Field testing of tanks, Underground Facilities including piping and conduits, and water-retaining structures.

C. Fill that includes organic materials or other unacceptable material shall be removed and replaced with approved fill material in accordance with the Contract Documents.

D. Placement – General:
   1. Place fill to the grades shown or indicated. Bring up evenly on all sides fill around structures and Underground Facilities.
   2. Fill areas shall be undercut and proof-rolled as directed by ENGINEER.
   3. Place fill materials at moisture content and density as specified in Table 31 23 05-A of this Section and this Article's requirements on compaction density. Furnish and use equipment capable of adding measured amounts of water to the fill materials to bring fill materials to a condition within required moisture content range. Furnish and use equipment capable of discing, aerating, and mixing the fill materials to ensure reasonable uniformity of moisture content throughout the fill materials, and to reduce moisture content of borrow materials by air drying, when necessary. When subgrade or lift of fill materials requires moisture-conditioning before compaction, fill material shall be sufficiently mixed or worked on the subgrade to ensure uniform moisture content throughout the lift of material to be compacted. Materials at moisture content in excess of specified limit shall be dried by aeration or stockpiled for drying.
   4. Perform compaction with equipment suitable for the type of fill material placed. Select and use equipment capable of providing the minimum density required in the Contract Documents. Use light compaction equipment, with equipment gross weight not exceeding 7,000 pounds within horizontal distance of ten feet from the wall of completed, below-grade structures. Furnish and use equipment capable of compacting in restricted areas next to structures and around piping and Underground Facilities. Effectiveness of the equipment selected by CONTRACTOR shall be tested at start of compacted fill Work by constructing a small section of fill within the area where fill will be placed. If tests on the test section of fill indicate that required compaction is not obtained, do one or more of the following: increase the amount of coverages, decrease the lift thicknesses, or use different compactor equipment.

5. Place fill materials in horizontal, loose lifts, not exceeding specified uncompacted thickness. Place fill in a manner ensuring uniform lift thickness after placing. Mechanically compact each lift, by not less than two complete coverages of the compactor. One coverage is defined as the conditions reached when all portions of the fill lift have been subjected to the direct contact of compactor's compacting surface. Compaction of fill materials by inundation with water is unacceptable.
6. Do not place fill materials when standing water is present on surface of the area where fill will be placed. Do not compact fill when standing water is present on the fill to be compacted. Do not place or compact fill in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material previously described shall be removed and replaced prior to compaction.
7. If required densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly-functioning compaction equipment, CONTRACTOR shall perform all work required to provide the required densities. Such work shall include, at no additional cost to OWNER, complete removal of unacceptable fill areas and replacement and re-compaction until acceptable fill is provided.
8. Repair, at CONTRACTOR's expense, observed or measured settlement. Make repairs and replacements as required within 30 days after being so advised by ENGINEER.

E. Fill Against Concrete:
1. Placing fill against concrete below finished grade is not allowed until the concrete has attained its specified strength, as determined by duration of concrete curing and testing of field-cured concrete cylinders. Requirements for strength and curing time are in Section 03 00 05, Concrete.
2. Elevation of fill placed against concrete walls shall not differ by more than two feet on each side of walls, unless walls are adequately braced or all floor framing is in place up to and including grade level slabs.
3. Backfill structural foundation units as soon as practicable, in accordance with this Section, after concrete has gained sufficient strength to avoid damage, to avoid ponding of surface water and accumulation of debris.
4. Where fill is placed against waterproofed surface, exercise care that waterproofing material is not damaged.

F. Fill in Electrical Ductbank Trenches:
1. Provide general fill for full depth of electrical ductbank trench, below and above electrical ductbank. Where one ductbank passes beneath another pipe or ductbank, provide select fill to the elevation of the bottom of upper ductbank or pipe, as applicable.
2. Placing and compacting fill in electrical ductbank trenches shall comply with requirements of Paragraph "G. Fill in Pipe Trenches", of this Article.

G. Fill in Pipe Trenches:
1. Place pipe bedding material in pipe trenches in horizontal layers, and thoroughly compact each layer before the next layer is placed.
2. Piping Installed in Fills Above Pre-construction Grade:
   a. Prior to installing piping, place the fill in accordance with the Contract Documents until the fill reaches a minimum elevation two feet higher than the top of piping to be installed. Excavate the trench; install the piping and backfill. Subsequently provide the remainder of the fill required for the Work.

3. Piping trenches may be backfilled prior to testing of piping, unless nature of the test requires observation of pipe during testing. Do not construct building or structure over piping until piping has been successfully tested and passed.
4. Pipe Bedding: Pipe bedding material shall be as indicated on the Drawings or as directed by the ENGINEER and in accordance with York County Standard Drawing Detail No. 15.02.
    a. Place loose backfill by hand around the pipe and completely under the pipe haunches in uniform layers not to exceed 6 inches in depth.
    b. Place each layer and then carefully and uniformly tamp with mechanical tamp, so that the pipe is not damaged nor the alignment disturbed.
    c. Depending upon soil and ground water conditions, greater depths (undercut) may be required to create a stable condition.
    d. When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation, stone stabilization shall be installed to develop a nonyielding foundation for the bedding and pipe. When such conditions are encountered, the trench shall be excavated to a depth determined by the ENGINEER, and #67 crushed stone shall be placed
5. Placing and Compacting Pipe Trench Fill: Unless otherwise shown, placement and compaction of pipe trench fill materials shall comply with the following:
    a. Pipe bedding material shall be spread and the surface graded to provide a uniform and continuous support beneath piping at all points between bell holes or pipe joints. Slight disturbance of installed pipe bedding material surface during withdrawal of pipe slings or other lifting tackle is acceptable.
    b. After each pipe's bedding material has been graded, and the piping has been aligned, joined in accordance with the Contract Documents, and placed in final position on bedding material, provide and compact sufficient pipe trench fill material under and around each side of the pipe and back of the bell or end thereof to hold piping in proper position and maintain alignment during subsequent pipe jointing and embedment operations. Deposit and compact pipe trench fill material uniformly and simultaneously on each side of piping to prevent lateral displacement of piping. Place and compact pipe trench fill material to an elevation 12 inches above top of pipe, unless otherwise shown or specified.
    c. Each layer of pipe trench fill material shall be compacted by at least two complete coverages of all portions of surface of each lift using appropriate compaction equipment.
    d. Method of compaction and compaction equipment used shall be appropriate for material to be compacted and shall not transmit damaging shocks to the piping.

H. Temporary Pavement:
1. Place 1-1.5 inches of temporary asphalt concrete pavement immediately after filling excavations in paved roadways and other paved areas that will remain for permanent use.
2. Maintain surface of paved area over the fill in good and safe condition during progress of the Work, and promptly fill depressions over and adjacent to the fill area caused by settlement of fill.
3. Permanent replacement pavement shall be equal to that of the existing roadways, unless otherwise shown or specified.

I. Subbase Placement:
1. Provide subbase material where shown to the limits shown or indicated.

2. Place subbase material in compacted lifts not exceeding depth of six inches each.

J. Drainage Fill Placement:
   1. Provide drainage fill material where shown to the limits shown or indicated.
   2. Place drainage fill material in compacted layers of uniform thickness not exceeding depth of six inches each. Compact lifts of drainage fill using suitable compaction equipment.

K. Compaction Density Requirements:
   1. Compaction required for all types of fills shall be in accordance with Table 31 23 05-A of this Section. Moisten material or aerate the material as necessary to provide the moisture content that will facilitate obtaining the required compaction.

TABLE 31 23 05-A
REQUIRED MINIMUM DENSITY

Material	Percent Compaction (ASTM D698)	Uncompacted Lift (inches)
General Fill		
More than five feet below final grade	100	8
Less than five feet below final grade	95	8
Select Fill		
Below concrete slabs or mats	100	8
Below pavement and sidewalks	100	12
Behind concrete walls	95	8
Subbase Material		
Below pavement and sidewalks	100	12
All other locations	100	8
Pipe Bedding Material		
Below structures or pavement	100	8
All other locations	95	6
Drainage Fill	N/A	6

   2. Fill shall be wetted and thoroughly mixed to achieve optimum moisture content plus-or-minus three percent, with the following exceptions:
      a. On-site clayey soils: Optimum to plus three percent.
   3. Replace natural, undisturbed soils or compacted soil subsequently disturbed or removed by construction operations with materials compacted as indicated in Table 31 23 05-A of this Section.
   4. Field quality control testing for density; to verify that specified density was obtained, will be performed during each day of compaction Work. Responsibility for field quality control testing is specified in the “Field Quality Control” Article in Part 3 of this Section.
   5. When field quality control testing indicates unsatisfactory compaction, provide additional compaction necessary to obtain the specified compaction. Perform additional compaction Work at no additional cost to OWNER until specified compaction is obtained. Such work includes complete removal of unacceptable (as determined by

ENGINEER) fill areas and replacement and re-compaction until acceptable fill is provided in accordance with the Contract Documents.

L. Replacement of Unacceptable Excavated Materials: In cases where over-excavation to replace unacceptable soil materials is required, backfill the excavation to required subgrade with select fill material and thoroughly compact in accordance with Table 31 23 05-A and the associated “Compaction Density Requirements” in this Article. Slope the sides of excavation in accordance with the maximum inclinations specified for each structure location.

3.11 GRADING

A. General:
   1. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth subgrade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free of irregular surface changes, and shall comply with the following:
   1. Grassed Areas or Areas Covered with Gravel, Stone, Wood Chips, or Other Special Cover: Finish areas to receive topsoil or special cover to within not more than one inch above or below the required subgrade elevations.
   2. Sidewalks: Shape surface of areas under sidewalks to line, grade, and cross section, with finish surface not more than one inch above or below the required subgrade elevation.
   3. Pavements: Shape surface of areas under pavement to line, grade, and cross section, with finish surface not more than 1/2-inch above or below the required subgrade elevation.

C. Grading Surface of Fill Under Concrete Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a ten-foot straight edge.

D. Compaction:
   1. After grading, compact subgrade surfaces to the depth and percentage of maximum density for each area classification.

3.12 PAVEMENT SUBBASE COURSE

A. Comply with York County Ordinance 154.110.

B. General:
   1. Place subbase material, in layers of specified thickness, over ground surface to support pavement base course.
   2. After completing filling and grading, shape and compact pavement subgrade to an even, firm foundation in accordance with this Section. Remove unsuitable subgrade

materials, including soft materials, boulders, vegetation, and loose stones, and replace with compacted fill material as directed by ENGINEER.

C. Grade Control:
   1. During construction, maintain lines and grades including crown and cross-slope of subbase course.

D. Placing of Pavement Subbase Course:
   1. Place subbase course material on prepared subgrade in layers of uniform thickness, in accordance with indicated cross-section and thickness. Maintain optimum moisture content for compacting subbase material during placing operations.
   2. Compaction and Grade Control: Comply with compaction requirements for excavation and fill in this Section, and the following requirements:
      a. Compaction with roller shall begin at the sides of the area to be paved and continue toward the center. Continue compaction until there is no movement of the course ahead of the roller.
      b. After compaction of top lift of pavement subbase, provide and uniformly spread pipe bedding material and screenings compacted, on the surface, and sweep using gang-dragged broom, followed by compaction.
      c. After rolling, check for grade with a line not less than 40 feet in length; depression over 1/2-inch deep shall be filled to satisfaction of ENGINEER.
   3. After completing compaction, other than that necessary for bringing material for the next course, do not haul or drive over the compacted subbase.
   4. Do not install pavement subbase in excess of 500 feet in length without compacting to prevent softening of the subgrade.
   5. If subgrade material becomes churned up into or mixed with the subbase material, remove the mixed material and replace with clean, compacted subbase material.

E. Shoulders:
   1. Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials placed in such quantity to compact to thickness of each lift of subbase material.
   2. Compact and roll not less than 12-inch width of shoulder simultaneously with compacting and rolling of each lift of subbase material.

3.13 DISPOSAL OF EXCAVATED MATERIALS

A. General:
   1. CONTRACTOR shall haul away material removed from excavations that does not comply with requirements for fill, or is in excess of the quantity required for fill.
   2. Disposal of materials shall be in compliance with Laws and Regulations, at no additional cost to OWNER.

3.14 TEMPORARY BARRIERS

A. Provide temporary barrier surrounding excavations and excavation work areas to provide temporary protection to persons and property. Barrier shall have openings only at vehicular, equipment, and worker access points.

B. Minimum Material Requirements for Temporary Barriers:

1. Temporary barrier shall not be less snow fence-type fencing, four feet high.
2. Fence shall be constructed of vertical hardwood slats measuring not less than 1.5 inches by 1/4-inch interwoven with strands of horizontal wire, or shall be of equivalent plastic construction.
3. Posts:
    a. Posts shall be steel, either “U”-, “Y”-, “T”-shaped, or channel section.
    b. Posts shall have a nominal weight of not less than 1/3-pound per linear foot, exclusive of the anchor.
    c. Posts shall have tapered anchors weighing not less than 0.67 pounds, each firmly attached by means of welding, riveting or clamping.
    d. Posts shall have corrugations, knobs, notches, or studs placed and constructed to engage a substantial number of fence line wire in the proper position.
    e. Provide each post with sufficient quantity of galvanized wire fasteners or clamps, of not less than 0.120-inch diameter, for attaching fence wire to post.

3.15 FIELD QUALITY CONTROL

A. Site Tests: OWNER will employ a testing laboratory to perform field quality control testing. Specific Quality Assurance Testing requirements and procedures shall be established on a Project-by-Project basis.
    1. Responsibilities and Duties of CONTRACTOR:
        a. Use of testing laboratory shall in no way relieve CONTRACTOR of the responsibility to provide materials and Work in full compliance with the Contract Documents.
        b. To facilitate testing laboratory, CONTRACTOR shall advise OWNER at least two days in advance of filling operations to allow for completion of field quality control testing and for assignment of personnel.
        c. It shall be CONTRACTOR’s responsibility to accomplish the specified compaction for fill and other earthwork. CONTRACTOR shall control construction operations by confirmation tests to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the Contract Documents relative to compaction, control.

END OF SECTION

SECTION 31 23 16.26

ROCK REMOVAL

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to perform rock removal required for the Work, including disposing of excavated rock material.
   2. Obtain permits required by authorities having jurisdiction for rock removal Work, including transporting, storing, and using blasting materials.
   3. Perform rock removal Work in compliance with Laws and Regulations applicable permits, and requirements of authorities having jurisdiction.

B. Coordination:
   1. Review procedures under this and other Sections and coordinate the Work that must be performed with or before rock removal.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. United States Bureau of Mines (USBM), Report of Investigations (RI) 8507.

1.3 TERMINOLOGY

A. The following words or terms are not defined but, when used in this Section, have the following meaning:
   1. “Rock removal” is removal of igneous, metamorphic, or sedimentary rock or stone; boulders over two cubic yards in volume in open areas and boulders over one cubic yard in volume in trenches; and mass concrete; that cannot be removed using rippers or other mechanical methods and therefore requires drilling and blasting or use of large excavator-mounted pneumatic breakers. The following material will not be measured nor allowed for payment as rock removal:
      a. Soft, weathered or disintegrated rock that can be removed by normal excavating equipment, including bulldozers with rippers and large trackhoes with rock teeth or rock buckets.
      b. Loose or previously blasted rock.
      c. Broken stone in rock fills.
      d. Rock or stone that falls into the excavation from outside limits of excavation shown or indicated in the Contract Documents.
      e. Boulders that can be removed without drilling, blasting, or pneumatic breakers.
      f. Pavements, sidewalks, and gutters of concrete, asphalt, or masonry.
   2. “Trenches” means excavations having vertical sides whose depth exceeds its width, made for Underground Facilities and drainage beds.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Professional Engineer:
      a. CONTRACTOR or blasting Subcontractor shall retain a registered professional engineer legally qualified to practice in South Carolina. Professional engineer shall have at least five years experience conducting preblast surveys, structural evaluations, and structural condition assessments.
      b. Responsibilities include:
         1) Preparing or supervising preparation of preblast survey.
         2) Preparing written requests for clarifications or interpretations of the Contract Documents for submittal to ENGINEER by CONTRACTOR.
         3) Signing and sealing preblast survey report.
         4) Performing condition assessments of structures damaged by blasting.

1.5 SUBMITTALS

A. Informational Submittals: Submit the following:
   1. Test and Evaluation Reports:
      a. Rock surface survey information, in accordance with Part 3 of this Section.
      b. Preblast survey report, in accordance with Part 3 of this Section.
      c. Blasting records, when requested by ENGINEER, in accordance with Part 3 of this Section.
      d. Vibration and overpressure monitoring results, in accordance with Part 3 of this Section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Top-of-Rock Survey:
   1. Prior to blasting and rock removal, CONTRACTOR shall survey and measure the elevation of the top of rock to determine the in-place quantity of rock to be excavated.
   2. Uncover rock to be excavated in sections or areas acceptable to ENGINEER for surveying.
   3. Submit to ENGINEER field notes, site plan showing rock elevations measured, cross-sections of rock surface when necessary or required by ENGINEER, and detailed estimation of quantity of rock to be excavated.

3.2 PREBLAST SURVEY

A. General:
   1. Preblast survey shall be performed or supervised by CONTRACTOR's or Subcontractor's professional engineer qualified in accordance with Part 1 of this Section.
   2. Complete preblast survey before starting blasting and rock removal.
   3. Preblast Survey Limits:

a. Preblast survey shall document the preblast condition, defects, and other physical factors that could reasonably be affected by blasting, of all existing residences; commercial, industrial, and institutional buildings; water supply wells; Underground Facilities and above-ground utilities; and other structures within the greater of the following distances from the limits of rock removal Work to be performed by blasting: 500 feet, or limit required in Laws and Regulations.
b. Preblast survey shall include structures such as dams, ponds and reservoirs, cisterns, structures of historical significance, and structures with unusually costly or vulnerable contents.
c. Preblast survey shall document the species and sensitivity of livestock and other animals that could be affected by blasting.

4. If, during the Work, CONTRACTOR is requested by a property owner or tenant to view alleged damage to property, CONTRACTOR shall give written notice to OWNER prior to visiting to the property.

B. Preparation for Preblast Survey:
1. Contact all owners and tenants, or their legal representative, of properties within limits of preblast survey to obtain permission to conduct preblast survey of the associated property. If property owner and tenant (if any) does not grant permission to conduct preblast survey, contact property owner and tenant (if any) a second time by registered mail (return receipt requested). Second request for permission to conduct preblast survey shall include description of preblast survey to be performed and purpose of preblast survey. At least 72 hours prior to starting blasting, provide to authority having jurisdiction, in writing, names and addresses of property owners and tenants (if any) who refuse access for preblast survey.
2. Notify property owners and tenants at least 48 hours prior to conducting preblast survey.
3. Not less than 48 hours before conducting blasting, submit preblast survey report as specified in Paragraph 3.2.D of this Section.

C. Method:
1. Buildings, Structures, Underground Facilities, and Above-ground Utilities:
a. Include in preblast survey detailed examination of interior and exterior of structures, Underground Facilities, and above-ground utilities located within specified limits of preblast survey.
b. Underground Facilities: With owner of Underground Facility, document condition of access points such as chambers, manholes, and vaults. Televise the underground pipes or conduits as noted in the Drawings.
c. Obtain color photographs, video, and prepare sketches and written descriptions to document the condition of areas within specified limits of preblast survey.
d. Document evident structural faults or deficiencies and recent repairs.
2. Wells: Include in preblast an assessment of water supply wells located within specified limits of preblast survey, including:
a. Information on well's date of construction, depth, method of construction, yield, water quality, and other existing available data. Obtain information from owner of well and installer (if known).
b. Perform short-duration pump test on each well utilizing existing pump serving the associated well. Activate pump, measure volume of water and drawdown in the well for period of one-hour or less until approximate steady state conditions are achieved. Use data obtained from these measurements to estimate approximate yield of each well.

c. Upon completion of specified short-duration pump test, obtain groundwater sample from well and submit to water quality laboratory certified by authority having jurisdiction for potable water wells. Cost of laboratory testing shall be paid by CONTRACTOR. Laboratory shall analyze samples for iron, manganese, total dissolved solids, turbidity and total coliform using methods acceptable to authority having jurisdiction for potable water wells.

D. Survey Report:
   1. General:
      a. Prepare written report summarizing results of preblast survey.
      b. Not less than 48 hours before blasting, submit two copies of completed preblast survey report to each authority having jurisdiction for their reference, if required. Submit one copy of preblast survey to OWNER, two copies to ENGINEER, and retain one copy at the Site.
      c. CONTRACTOR's or Subcontractor's professional engineer shall sign and seal final preblast survey report.
   2. Contents: Preblast survey report shall contain the following:
      a. Location and description of each property within or partially within the specified preblast survey limits.
      b. Descriptions of conditions of buildings, structures, Underground Facilities, above-ground utilities, wells, and other elements included in the preblast survey.
      c. Summary of visual observations and inspections.
      d. Color photographs, sketches, and video as appropriate.
      e. All data, results, and yield estimates developed from water supply well assessments.
   3. Photographic Documentation: Provide video to present supplemental information, as required. Include in photographs and video (where appropriate) a scale to indicate dimensions. Label photographs with name of the professional engineer responsible for preblast survey, name of property owner, and sufficient information to determine the location of the image. Include in preblast survey report one print of each photograph and include discs with video and electronic copies of photographs.
   4. CONTRACTOR's or Subcontractor's professional engineer shall report all findings that, in professional engineer's opinion, indicate that building, structure, Underground Facility, above-ground utility, or well will be adversely affected by the rock removal and blasting Work.

3.3 BLASTING AND ROCK REMOVAL

A. Notify the York County Department of Fire Safety – Fire Prevention Section or the York County Fire Administrator and obtain blasting permits prior to commencing any blasting operations.

B. Perform blasting in accordance with Laws and Regulations relative to blasting, storage and use of explosives, and rock removal.

C. Perform rock removal adjacent to Underground Facilities and above-ground utilities and life-safety facilities with utmost care, after properly notifying and coordinating with utility owners, life-safety facility owners, and authorities having jurisdiction.

D. Perform blasting to avoid endangering persons or property, and damaging or weakening adjacent foundations, structures, sheeting, bracing, and other facilities. Cover or otherwise suitably confine blasting.

E. CONTRACTOR shall be fully responsible for injury and damage caused by blasting, and shall repair or replace all injury and damage immediately, as accepted by ENGINEER at no additional cost to OWNER.

F. Limit Criteria for Blasting Vibration, Particle Velocity, and Airblast Overpressure:
   1. Amount of vibration, frequency and overpressure generated by blasting shall not exceed limits in Laws or Regulations, and limits established by authorities having jurisdiction.
   2. Maximum peak particle velocity (PPV) shall not exceed limits indicated in Figure B-1, Appendix B, of the USBM RI 8507.
   3. Peak airblast overpressure measured at location of nearest occupied, above-ground structure (considering wind direction) shall not exceed 0.014 psi.

G. Keep records of all blasts, including: date; location, depth, number, and diameter of drill holes; type and amount of explosive; and other pertinent data. Submit records to ENGINEER when requested.

H. Removal by Methods Other than Blasting:
   1. Where conditions of hazard exist, or clearances with existing facilities, piping, or structures are very small, or where the potential for damage to persons or property is strong, perform rock removal by means other than blasting.
   2. Blasting is not allowed except in areas where so allowed by Fire Department Blasting Permit as issued by the Office of State Fire Marshal.

I. Removal and Disposal of Rock:
   1. Remove blasted or broken rock from excavations with suitable equipment.
   2. Do not use excavated rock as backfill. Dispose of excavated rock off the Site at CONTRACTOR's expense in compliance with Laws and Regulations.

3.4 SITE QUALITY CONTROL

A. Blast Monitoring:
   1. Perform seismic blast monitoring in accordance with Laws and Regulations.`
   2. Monitor blasting to allow evaluation of compliance with the limitations specified in the Contract Documents. At minimum, monitor each blast as follows:
      a. Blast Monitoring Zone: Monitor vibrations at exterior walls of all structures within 500 feet of each blast.
      b. If no structures are located within specified blast monitoring zone, monitor vibrations at three equally spaced radial points located at perimeter of specified blast monitoring zone.
      c. Monitor overpressures for all structures within specified blast monitoring zone.
   3. Submit vibration and overpressure monitoring results to ENGINEER within 24 hours of blasting. CONTRACTOR's monitoring does not relieve CONTRACTOR of responsibility for controlling vibration and overpressure during blasting.

3.5 UNAUTHORIZED ROCK REMOVAL

A. Rock removal outside the limits shown or indicated in the Contract Documents or that is not approved by ENGINEER, including removal, disposal, and backfill, will be at CONTRACTOR's expense.

B. Fill unauthorized excavation below pipe or foundation with compacted select backfill as directed by ENGINEER in writing, at no additional cost to OWNER. Backfill other unauthorized excavation as specified in Section 31 23 05, Excavation and Fill.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals required to furnish and install riprap at locations shown or indicated in the Contract Documents.

B. Coordination:
   1. Review procedures under this and other Sections and coordinate the Work that must be performed with or before riprap.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 31 11 00, Clearing and Grubbing.
   3. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM C127, Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
   2. NSSGA-293, Aggregate Handbook.
   3. South Carolina Department of Transportation (SCDOT) Qualified Products Listings and Policies for Construction and Maintenance Materials.
   4. South Carolina Department of Transportation Standard Specifications for Highway Construction.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Riprap Supplier:
      a. Supplier of riprap and other materials furnished under this Section shall be certified by the SCDOT for furnishing such materials for SCDOT highways.

B. Regulatory Requirements:
   1. Reference Specifications and Details:
      a. Comply with applicable requirements of SCDOT Standard Specifications for Highway Construction.

1.4 SUBMITTALS

A. Acton Submittals: Submit the following:
   1. Product Data:
      a. Source or quarry name, gradation, and other information required by ENGINEER. Submit for each source of material proposed.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Where material is specified according to reference specification item number, submit copy of Supplier's valid certification from entity issuing the reference specification, and associated certification of material conformance with the reference specifications.

PART 2 PRODUCTS

2.1 MATERIAL

A. Riprap: Material shall comply with Section 804 of SCDOT Standard Specifications for Highway Construction, Class B and shall be obtained from sources listed on the most recent edition of SCDOT Qualified Products List 2.

B. Width and thickness of each stone shall not be less than one-third the length of the stone.

PART 3 EXECUTION

3.1 PREPARATION

A. Clear ground surface of brush, trees, stumps, and other objectionable material, and dress to a smooth surface. Clearing and grubbing, where required, shall comply with Section 33 11 00, Clearing and Grubbing.

B. Remove all soft or spongy material to depth shown or indicated on the Drawings or as directed by ENGINEER, and replace with acceptable material. Excavation, removal of unsuitable material if any, and backfilling shall comply with Section 31 23 05, Excavation and Fill.

3.2 INSTALLATION

A. Riprap Placing:
   1. Minimum total thickness of riprap shall be as specified in Article 2.1 of this Section.
   2. Place riprap stones so that weight of stone is carried by underlying material and not by adjacent stones. Carefully place the stones on geosynthetics, where required, to produce an even distribution of pieces, with minimum of voids and without damaging the geosynthetic. Place the full-course thickness in one operation while preventing segregation and avoiding displacing of underlying material. Do not place stones in layers, by dumping into chutes, or by other methods that cause segregation or damage to geosynthetic, if any. When necessary, rearrange individual stones for uniform distribution.
   3. Riprap may be placed using equipment, and placing shall produce an installation of firm and solid riprap. Level the top surface of riprap to required alignment and slope by hand-placing stones to fill large voids and to make surface even.
   4. On slopes, place the largest stones at the bottom. Riprap shall be properly sized to form compact, solid blanket to protect the slope or channel, as applicable.
   5. Rip-rap shall be installed no steeper than a 2:1 slope except when specifically approved by the Engineer. On such slopes, do not use rounded boulders or cobbles without grouting stones in place.

6. Grouting: Where grouting of riprap is required, comply with the following:
   a. When stones are in place, completely fill spaces between stones with “grout fill” material in accordance with Section 03 00 05, Concrete.
   b. ENGINEER may direct that occasional spaces be left ungrouted for relief of hydrostatic pressure. Chink ungrouted spaces with spalls of suitable size.
   c. Do not grout riprap in freezing weather.
   d. Clean exposed surface of stones to remove accumulation of grout.
   e. Keep grouted riprap moist for seven days after grouting. Suitable grout curing compound may be employed when approved by ENGINEER.
7. When existing riprap is in proximity to riprap provided under this Section, place riprap to conform as closely as practicable in size and character to existing riprap.
8. Unless otherwise indicated, existing riprap removed to facilitate other Work shall be reinstalled or replaced at no additional cost to OWNER.
9. In locations where a creek bank is eroded near a sewer line, before placing riprap, place compacted fill material along the creek bank in order to maintain 3 feet of cover over the sewer line.

END OF SECTION

SECTION 31 62 16.16

STEEL H-SECTION PILES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and test steel H-section piles.
   2. Extent of steel H-section piling is shown on the Drawings.
   3. Included are:
      a. Furnishing, driving, cutting off, and all other steel H-section piling Work.
      b. Providing openings in and attachments to steel H-section piling to accommodate the Work under this and other Sections, and providing for steel H-section piling all items required for which provision is not specifically included under other Sections.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before steel H-section piling Work.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASTM A572/A572M, Specification for High-Strength Low-Alloy Columbium- Vanadium Structural Steel.
   2. ASTM D1143/D1143M, Test Method for Deep Foundations Under Static Axial Compressive Load.
   3. ASTM D3689, Test Methods for Deep Foundations Under Static Axial Tensile Load.
   4. ASTM D3966, Test Methods for Deep Foundations Under Lateral Load.
   5. ASTM D4945, Test Method for High-Strain Dynamic Testing of Piles.
   6. ASTM D7091, Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
   7. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
   8. ASTM E376, Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Examination Methods.
   9. AWS D1.1/D1.1M, Structural Welding Code – Steel.
   10. International Building Code.
   11. Ozone Transport Commission (OTC) Architectural and Industrial Maintenance Coatings.
   12. SSPC-PS 11.01, Black (or Dark Red) Coal Tar Epoxy Polyamide Painting System.
   13. SSPC-SP 1, Solvent Cleaning.
   14. SSPC-SP 10/NACE No. 2, Near White Blast Cleaning.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Welders and Welding Processes:
      a. Qualify welding processes and welding operators in accordance with AWS D1.1/D1.1M, Section 5, Qualification.
      b. Each welder employed on or to be employed for the Work shall possess current AWS certification in the welding process with which welder will be working. Certifications shall be current and valid throughout the Work.
   2. Surveyor:
      a. Engage a registered professional land surveyor legally qualified to practice in the same jurisdiction as the Site, and experienced in providing surveying services of the kind indicated.
      b. Responsibilities include but are not necessarily limited to:
         1) Performing or supervising performance of field survey work to check lines and elevations of steel H-section piling, before proceeding with construction of pile caps.
         2) Submit to CONTRACTOR field survey reports.
   3. Professional Engineer:
      a. Retain the services of a registered professional engineer, legally qualified to practice in the same jurisdiction as the Site, to design all required static load-testing apparatus, including loaded members, support frames, loading procedures, and test movement recording devices. Test beams, load platforms, and support structures, as required, shall have sufficient size, strength, and stiffness to prevent excessive deflection and instability up to the maximum anticipated load.
      b. Responsibilities include but are not necessarily limited to:
         1) Reviewing load testing criteria stated in the Contract Documents.
         2) Preparing or supervising preparation of design calculations and related drawings, Shop Drawings, and loading procedures.
         3) Signing and sealing all calculations, design drawings, and Shop Drawings.
         4) Certifying that:
            a) it has performed the design of the loading apparatus in accordance with design criteria stated in the Contract Documents, and
            b) said design complies with Laws and Regulations, and complies with prevailing standards of practice.
   4. Dynamic Pile Testing Consultant:
      a. Retain the services of a dynamic pile testing consultant to provide necessary equipment, and perform dynamic testing and wave equation analysis to determine the ultimate pile capacity of dynamically-tested piles as indicated in the Contract Documents.
      b. Dynamic pile testing consultant shall be a professional engineer legally qualified to practice in same state as the Site and shall have a minimum of five years experience with dynamic pile testing, data interpretation, and wave equation analysis.
      c. Responsibilities include but are not necessarily limited to:
         1) Preparing or supervising preparation of the dynamic pile testing plan.
         2) Preparing or supervising the preparation of test set-ups.
         3) Performing or supervising performance of testing, interpretation, and engineering analysis of test data, and preparing test reports.
         4) Signing and sealing the dynamic pile testing report.
   5. Pile Installer:
      a. Engage an experienced pile installer possessing a minimum of five years experience installing piles similar to those required in this Section, to perform all H-section pile driving indicated in the Contract Documents.

6. Static Load Test Application and Recording of Data:
    a. Maintain presence of experienced employees at all times during steel H-section pile Work to perform the required loading and recording of data during static load testing. Individuals responsible for the Work shall have a minimum of five years of experience in similar projects.

B. Regulatory Requirements:
1. If coatings are required, comply with VOC content limits of OTC Model Rule for Architectural and Industrial Maintenance Coatings:
    a. Industrial Maintenance Coatings: 340 grams per liter.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings: Submit the following in advance of start of pile driving:
    a. Drawings showing location of all piles. Assign an identification number to each pile coinciding with identification number used in driving record of each pile. Shop Drawings shall include anticipated driving sequence for the Work.
    b. Complete data on type of pile proposed, including pile installation procedures.
    c. Submit detailed drawings of pile splices. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld, as applicable.
    d. Submit detail of pile tension connection. Clearly indicate welds using standard AWS notations and symbols, and clearly show or indicate size, length, and type of each weld, as applicable.
2. Product Data:
    a. Copies of manufacturer's specifications and installation instructions for products listed below.
        1) Welding electrodes and rods.
        2) Protective coating manufacturer's technical information and test performance data, including paint analysis, VOC and chemical component content in comparison to maximum allowed by the Contract Documents, and application instructions. Submit proof of acceptability of proposed application techniques by paint manufacturer selected.

B. Informational Submittals: Submit the following:
1. Certificates.
    a. Welders' certifications.
    b. Laboratory test reports and other data as required to demonstrate compliance with these Specifications for the products listed below:
        1) Structural steel of each type, including certified copies of mill reports covering chemical and physical properties.
2. Complete data on hammer and other driving equipment to be utilized, including results of drivability studies.
3. Pile Load Test Plan:
    a. Submit pile load test plan, including complete data on test pile instrumentation, load application, apparatus for recording movement, and protection of testing apparatus, at least 30 days prior to installing the first test pile. ENGINEER's acceptance of pile load test plan shall not relieve CONTRACTOR of responsibility for structural and operational adequacies of the testing system.

1) Dynamic load test requirements included in the pile load test plan shall be prepared by CONTRACTOR's dynamic pile load testing consultant.

b. Calibration curve for jack and gauge to be used for static load testing, to demonstrate compliance with required ASTM standards, certified by testing laboratory.

c. Calibration statements for equipment to be used to obtain dynamic measurements, record, reduce and display data to demonstrate compliance with ASTM D4945, certified by testing laboratory.

4. Field Quality Control Submittals:
   a. Static Load Test Reports: Within two days of completing test, submit test report for each pile test, in accordance with Article 3.6 of this Section.
   b. Dynamic Test Report: Submit dynamic test report, including wave equation analysis, within seven days after completing tests.
   c. Coating Test Reports: Submit test report within two days of completing holiday tests and dry film thickness tests.
5. Driving Records:
   a. Within two days of driving, submit copies of driving record of each pile, including the following information:
      1) Project name, Contract number, report date, date of pile driving.
      2) CONTRACTOR and Subcontractor names.
      3) Pile location and number.
      4) Pile section designation.
      5) Starting and finishing driving times.
      6) Type and size of hammer.
      7) Pile driving cap type.
      8) Ground, tip, and butt elevation. Indicate butt elevation before and after cut-off.
      9) Total pile pay length.
      10) Locations of splices, if any.
      11) Continuous record of number of blows for each foot of penetration and for each inch of penetration in the last foot of penetration.
      12) Data on and description of unusual occurrences, if any, during pile driving.
6. Qualifications Statements.
   a. Land surveyor.
   b. Professional engineer.
   c. Dynamic pile testing consultant.
   d. Pile installer.
   e. Qualifications of each individual employed to perform static load test application and recording of data.

C. Closeout Submittals: Submit the following:
   1. Field survey reports showing exact location of each steel H-section pile as driven, including record drawings and data showing final position of top of each pile. Include location of rejected piles.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Except for piles to be used for testing, materials ordered or delivered to the Site prior to verification of assumed pile length are at CONTRACTOR's risk.
   2. After pile lengths are verified, deliver materials to Site in such quantities and at such times to ensure continuity of pile driving operations in accordance with the Progress Schedule accepted by ENGINEER.

B. Storage: Store piles in orderly groups above ground on blocks to minimize potential for distortion.

C. Handling:
   1. Lift piles using a cradle or multiple point pick-up to ensure that the maximum permissible camber or sweep is not exceeded due to insufficient support. Point pick-up devices shall be of the type that clamps to both pile flanges at each pick-up point.
   2. Holes may be burned in the flanges or webs of piles above the cut off length for lifting piles into the leads.
   3. Do not drag piles across the ground.
   4. Piles with excessive camber or sweep will be rejected.

1.6 SITE CONDITIONS

A. Site Information:
   1. Information on subsurface conditions is available in the reports listed in the Supplementary Conditions.
   2. Additional test borings and other exploratory operations may be made by CONTRACTOR at no additional cost to OWNER, provided such operations are acceptable to ENGINEER.

B. Line and Level:
   1. Using reference points and engineering surveys provided by OWNER, establish and locate all other lines and levels and is responsible for the correct location and deviation of all piles.
   2. Install piles at the proper locations and orientation shown or indicated in the Contract Documents.

PART 2 PRODUCTS

2.1 MATERIALS

A. H-Section Piles:
   1. Provide structural H-section shapes, complying with ASTM A572/A572M, Grade 50, of the sizes shown or indicated on the Drawings.

2.2 PROTECTIVE COATINGS

A. Coating Material:
   1. Surface Preparation: Refer to Paragraph 3.2.A of this Section.
   2. Shop Applied Coating and Field Touch-Up Materials:
      a. Coal Tar Epoxy Polyamide:
         1) System: SSPC-PS 11.01.
         2) Material: SSPC Paint 16.
      b. Products and Manufacturers: Provide one of the following:
         1) Hi-Mil Sher-Tar Epoxy B69B40/B60V40, manufactured by Sherwin Williams Company.
         2) Hi-Build Tneme-Tar, Series 46H-413, manufactured by Tnemec Company, Inc.
         3) Or equal.

2.3 PILE TENSION CONNECTIONS

A. Provide steel H-section piling with tension connections to the pile cap as shown on the Drawings.

B. Pile tension connections shall comply with the details on the Drawings.

2.4 DRIVING EQUIPMENT

A. General:
   1. Drive piles with a drop, single- or double-acting steam, air, or diesel hammer. Use a hammer with sufficient energy to drive piling to required tip elevation without damaging the pile. Operate double-acting hammer, if used, at full-rated pressure and speed during final driving of pile. When using single-acting hammer, maintain valve mechanism as recommended by manufacturer so that length of stroke is maintained. Equip diesel hammers, when used, with chambers and gages arranged so that precise energy information can be read and recorded. Hammer shall be in good operating condition at all times during driving.
      a. Size or capacity of hammers shall be as recommended by hammer manufacturer for the total pile mass weight and character of soil formation to be penetrated.
      b. Perform drivability studies that are based on wave equation analysis. Drivability study shall demonstrate hammer can successfully drive the piles to the anticipated pile tip elevations and with sufficient energy to produce design pile capacity without damage to the pile and without excessive blow count.
      c. Provide further wave equation analysis at no cost to OWNER if hammer system is replaced or modified.

B. Driving Caps:
   1. Equip hammer with cushioned or blocked driving cap, conforming to pile shape, with loss of hammer energy kept to a minimum. Keep bearing surfaces of driving cap true and smooth.
      a. Driving cap shall be consistent with the wave equation analysis.

C. Pile Driving Leads:
   1. Use fixed or rigid type pile driving leads that will hold pile firmly in position and in axial alignment with hammer. Free-swinging leads are unacceptable. Extend leads to within two feet of elevation at which pile enters ground.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which steel H-section piling will be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Inspect piles for excessive camber and sweep, and for damage before transporting pile materials from storage area to driving location, and inspect immediately prior to placing pile material in the driving leads. Measure camber and curvature in the pile in direction normal to the

pile flanges, with the pile flange laying on the surface; measure the distance between the flange base at mid-length of pile and the flat surface. Measure sweep and curvature in the pile in direction parallel to the pile flanges with the pile flange tips laying on a flat surface; measure the distance between flange tips at mid-length of the pile and the flat surface. Maximum acceptable camber or sweep is two inches over the length of the pile.

3.2 PROTECTIVE COATINGS

A. Provide protective coating for pilings in corrosive soils, pilings exposed above-ground or if otherwise indicated in the Drawings.

B. Cleaning and Preparation of Coated or Painted Surfaces:
   1. Solvent Cleaning:
      Remove visible oil, grease and other contaminants by solvent cleaning in accordance with SSPC-SP 1.
   2. Blast Cleaning:
      a. After solvent cleaning, complete surface preparation by near-white blast cleaning in accordance with SSPC-SP 10/NACE No. 2. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping.
      b. Comply with paint manufacturer's recommendations for type and size of abrasive to provide surface profile that complies with manufacturer's painting system requirements.

C. Mixing:
   1. Mix and prepare paint products in accordance with paint manufacturer's product literature and manufacturer's preparation instructions.

D. Application:
   1. Apply coating to blast-cleaned steel in accordance with paint manufacturer's written instructions.
   2. Coal-tar Epoxy: Apply by spraying one coat to total minimum dry film thickness of 16 mils and maximum dry film thickness of 20 mils.
   3. Provide finish coating that is generally smooth and free of projections that can be removed by abrasion. Remove sharp edges and repair areas in accordance with paint manufacturer's directions.

E. Field Touch-Up:
   1. Touch-up damaged shop-applied paint using materials as specified under Article 2.2 of this Section in accordance with paint manufacturer's instructions.

3.3 PREPARATION FOR PILE INSTALLATION

A. Preparation of Site:
   1. Do not drive piles until earthwork in the area where piles will be installed has been performed as follows:
      a. Excavation, fill, and earthwork shall be in accordance with Section 31 23 05, Excavation and Fill.
      b. Excavation: Stop excavating at elevation six inches to twelve inches above bottom of footing before piles are driven. Final excavation to required elevation of footing bottoms shall be after piles are installed and tested.
      c. Fills: Construct and compact fills to elevation shown.

2. Do not drive pile within 15 feet of concrete or masonry structure that has not attained its full design strength.

B. Pile Length Markings:
   1. Mark length of pile by painting the number of feet from pile tip at five foot intervals and painting a horizontal line, at 12-inch intervals, starting 15 feet below pile cut-off.

C. Welding:
   1. Perform manual arc welding using shielded metal arc method or submerged arc method complying with AWS D1.1/D1.1M.
   2. Use oxygen-gas or oxygen-arc methods for field cutting steel, complying with AWS D1.1/D1.1M.

D. Splices:
   1. In general, use only one splice per length of pile.
      a. Piles that have not reached required tip elevation or refusal blow count when the top has been driven to cutoff elevation shall be spliced as shown and driven to sufficient depth to develop the required tip elevation or refusal blow count.
   2. Clean surfaces to be welded of rust, scale, oil, paint, and foreign material. Use only pile members with identical cross-sections for splicing.
   3. When possible, make splices before starting driving operations. If welded splice is required during driving operation, make splice when top of driven pile portion is at least three feet above ground, to allow inspection of welded connection during welding and during subsequent driving. Length of pile to be spliced shall be secured in proper alignment to avoid eccentricity.
   4. Splices shall be 100 percent butt welded, producing a straight pile alignment through splice and developing full bending strength and axial load strength of pile.
   5. After splices are made, inspected, and acceptable to ENGINEER, touch-up and repair protective coatings on piles using same material used in shop-applied paint or coating systems, in accordance with manufacturer's instructions.

E. Pre-drilling:
   1. Pre-drilled holes for pile installation are allowed only when approved by geotechnical engineer or ENGINEER of record.

F. Jetting:
   1. Jetting and spudding of piles is not allowed.

3.4 DRIVING PILES

A. Protection:
   1. Protect structures, Underground Facilities, and other construction from damage caused by pile driving operations.
   2. When structures are adjacent to pile driving operations, before commencing pile driving, provide surveyed elevation benchmarks on structure at locations directed by ENGINEER. Record and report the elevation of each benchmark after driving each pile and at least twice a day while pile driving is in progress. Should benchmark readings indicate displacement, halt pile driving operations until corrective action is provided acceptable to ENGINEER.

B. General:

1. Provide written notice prior to beginning construction on steel piles to OWNER and ENGINEER. Don't perform any pile driving without Inspector present.
2. Perform pile driving in an orderly sequence, progressing in one direction across each foundation element. Do not install piles in area surrounded by previously driven piles. Drive piles only in ENGINEER's presence.
3. Continuously drive each pile at location indicated, to the required tip elevation and driving resistance established by driving and loading of test piles and load testing analysis.
    a. Piles shall be driven to resistance or pile refusal criteria provided by the geotechnical engineer or as indicated on the Drawings.
4. Carefully maintain center of gravity for each group or cluster of piles to comply with locations shown.
5. Carefully plumb leads and pile before driving. During driving prevent and correct tendency of piles to twist or rotate.
6. When handling and driving long piles, take special precautions to prevent overstress or leading away from true position.

C. Obstructions:
1. Should an obstruction including, but not limited to, boulders, rock, rubble, fill, or existing foundations be encountered that prevents driving of pile to its required tip elevation or final driving resistance, threaten pile damage, or cause pile to drift from required location, cease driving operation and contact ENGINEER immediately. ENGINEER will determine corrective measures, including, but not necessarily limited to, pile relocation and pile cap design modifications required to accommodate the obstruction. Corrective measures due to obstructions, including cost of redesign, will be paid by OWNER via a Change Order or other method in accordance with the Contract Documents.

D. Driving Tolerances:
1. Drive piles within the following maximum tolerances:
    a. Location: Three inches from location indicated for center of gravity of each single pile or pile groups; one inch for piles under walls.
    b. Plumbness: Maintain one inch in ten feet from vertical, or a maximum of four inches, measured when the pile is above ground, in the leads.
    c. Batter Angle: Maximum one inch in ten feet from required angle as shown on the Drawings, measured when pile is above ground and in the leads.

E. Cutting-Off:
1. Cut off tops of driven piles square with pile axis and at elevations indicated, using cutting torch or other acceptable method.
2. Piles driven below required cutoff elevation are not acceptable and shall be replaced at no additional cost to OWNER.
3. Recoat cut off tops of piles that have protective coating. Touch-up and repair protective coatings on piles using same material used in shop-applied coating systems, in accordance with paint manufacturer's instructions.

3.5 REPAIRS AND CORRECTIONS

A. Corrective Action:
1. ENGINEER may survey piles at any time. If heave or other discrepancy is detected, re-drive or replace the pile or piles at no additional cost to OWNER.

2. As soon as possible after completing pile driving, prepare an accurate survey by licensed surveyor. Partial surveys of piles at cutoff elevation can be submitted as driving proceeds to expedite the Work.
3. ENGINEER will check piling and determine acceptability. If unacceptable, ENGINEER will advise CONTRACTOR what additional piles shall be provided or other corrective measures to be taken.
4. ENGINEER will provide redesign, as required, for corrections required for piles driven out of location. Corrective measures, including cost of redesign, shall be paid by CONTRACTOR via Change Order.

B. Damaged or Misdriven Piles:
1. Damaged piles and piles driven outside required driving tolerances, piles that are too short to develop the required final driving resistance or required tip elevation, or that otherwise do not comply with the Contract Documents, are considered defective and are unacceptable.
2. Damaged piles shall include, but not necessarily be limited to, piles that are bent, buckled, fabricated without complying with tolerances in the Contract Documents, or piles fabricated with defects that may weaken the pile, as determined by ENGINEER.
3. Replace damaged or misdriven piles as directed by ENGINEER at no additional cost to OWNER. ENGINEER will provide redesign, as required, for corrections required for damaged or misdriven piles. Corrective measures, including cost of redesign, shall be paid by CONTRACTOR via Change Order
    a. When possible, withdraw rejected piles and replace with new piles. Withdrawal method shall be submitted to ENGINEER for approval.
    b. If withdrawal of damaged or misdriven pile is impossible or impractical, cut off pile below the limits of the structure, and install required additional piles and other corrective measures, such as modifications to the cast-in-place concrete pile cap, as required by ENGINEER's redesign.

C. Heaved Piles:
1. Using data provided by CONTRACTOR, ENGINEER will determine whether a driven pile has lifted from its original seat during driving of adjacent piles. If uplift occurs, re-drive affected piles to a tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance.

D. Cost of ENGINEER's Redesign:
1. Piling driven incorrectly, or in position other than that shown on the Contract Documents ("out of position"), or that is otherwise defective, shall be corrected as directed by ENGINEER and as described in this Section. For such piles, CONTRACTOR shall pay OWNER for cost of engineering, Resident Project Representative, and inspection services associated with evaluating and correcting incorrectly installed, out-of-position, or defective piles.
2. ENGINEER will record time of ENGINEER and ENGINEER's consultants and expenses required, if any, for evaluating defective piles and redesigning piling, foundations, and other related structural elements and in making revisions to the Contract Documents.
3. Cost of services of ENGINEER and ENGINEER's consultants shall be based on a charge of 3.0 times direct salary cost of each employee and 1.1 times the cost of expenses.

3.6 FIELD QUALITY CONTROL

A. Furnish, install, and load-test piles to verify design pile lengths and loads to be tested by the specified test method indicated by the geotechnical engineer. Provide complete testing materials and equipment as required. Perform tests in presence of ENGINEER.

B. Test piles used for determining lengths of piles may be located, cut off, and become part of the foundation system if test piles comply with requirements of the Contract Documents. Test piles which aren't to be incorporated in the completed structure shall be removed to at least 2 feet below the surface of the ground or the stream bed, and the remaining hole backfilled with earth or other suitable material.

C. Test Piles shall be as shown on the Drawings.

D. Driving Test Piles:
   1. Use test piles of same size and design as required, and drive with appropriate pile driving equipment operating at rated driving energy required for driving permanent piles.
   2. Drive test piles at locations designated by ENGINEER in the same manner as required for permanent piles.

E. Pile Design Load:
   1. Design load per pile shall be as shown on the Drawings.

F. Dynamic Testing of Piles (Bearing):
   1. CONTRACTOR's dynamic pile testing consultant shall perform dynamic pile testing in accordance with ASTM D4945.
   2. Perform dynamic pile testing using a pile driving analyzer (PDA) on three bearing piles. Perform dynamic testing as a minimum during the final five feet of piling driving.
   3. Restrike test piles with concurrent PDA testing after a minimum waiting period as approved by the ENGINEER.
   4. Perform wave equation analysis (two, minimum) using the field-measured data from the three test piles.
   5. CONTRACTOR's dynamic pile testing consultant shall certify that all dynamic testing was performed correctly and submit a signed and sealed written report upon the completion of testing. Submitted dynamic testing report shall include field information required for driving reports under the Submittals Article of this Section, detailed test procedures, dynamic pile test results, including results from wave equation analyses, and provide recommendations for production pile installation.
   6. Dynamic testing report prepared by CONTRACTOR's dynamic pile testing consultant shall be submitted for review by the ENGINEER not less than 10 days prior to commencing production pile Work.
   7. Based on observations and results of dynamic testing, ENGINEER will indicate minimum pile tip elevations or blow count criteria to be used during driving of production piles.

G. Static Test Loads:
   1. Static tension, compression, and lateral test load for individual piles shall be two times the required design load.

H. Static Compression Load Testing:
   1. Load and test piles to determine and record the load-movement relationship of the test piles under vertical compression load complying with ASTM D1143/D1143M.
   2. Apply compression load by hydraulic jacks acting against anchored reaction frame. Testing apparatus shall comply with ASTM D1143/D1143M. Provide the necessary framing at each

load test to allow ENGINEER unrestricted safe access to pile instrumentation at all times during the load test. Hydraulic jacks, gauges, transducers, and load cells shall comply with ASTM D1143/D1143M. Submit certified calibration curve for the jack and gauge to be used in the testing.

3. Apply minimum specified test load in accordance with Procedure B of ASTM D1143/D1143M.
4. Record pile movement using a reference system constructed independently of the pile and loading apparatus and firmly embedded in the ground at locations clear of load supports, and clear of the zone of influence of the pile loadings and reaction supports. Apparatus for measuring movement shall comply with ASTM D1143/D1143M. Provide equipment and personnel required to obtain the level observations required by the Contract Documents.
5. Protect load test set-up from inclement weather by tarpaulins and protective ditches and, if protection from freezing weather is necessary, provide temporary space heaters.

I. Static Tension Load Testing:
1. Load and test piles to determine and record the load-movement relationship of the test piles under vertical tension load in accordance with ASTM D 3689.
2. Apply tensile load by hydraulic jacks supported on test beams. Testing apparatus shall comply with ASTM D3689. Provide necessary framing at each load test to allow ENGINEER unrestricted safe access to pile instrumentation at all times during load test. Hydraulic jacks, gauges, transducers, and load cells shall comply with ASTM D3689. Submit certified calibration curve for the jack and gauge to be used during testing.
3. Apply the minimum specified test load in accordance with Procedure B of ASTM D3689.
4. Record pile movement using a reference system constructed independently of the pile and loading apparatus and firmly embedded in the ground at locations clear of load supports, and clear of zone of influence of pile loadings and reaction supports. Apparatus for measuring movement shall comply with ASTM D3689. Provide equipment and personnel necessary to obtain the level observations required by the Contract Documents.
5. Protect load test set-up from inclement weather by tarpaulins and protective ditches and, if protection from freezing weather is necessary, provide temporary space heaters.

J. Static Lateral Load Testing:
1. Load and test piles to determine and record the load-movement relationship of test piles under lateral load, complying with ASTM D3966.
2. Apply lateral load by hydraulic jacks acting against a reaction system. Testing apparatus shall comply with ASTM D3966. Provide the necessary framing at each load test to allow ENGINEER unrestricted safe access to pile instrumentation at all times during load test. Hydraulic jacks, gauges, transducers, and load cells shall comply with ASTM D3966. Submit certified calibration curve for the jack and gauge to be used during testing.
3. Test piles as free-head piles. Apply minimum specified test load in accordance with Procedure A of ASTM D3966. Direction of test for the H-piles shall be in the weak axis.
4. Record pile movement using reference system constructed independently of the pile and loading apparatus, firmly embedded in the ground at locations clear of load supports and clear of zone of influence of pile loadings and reaction supports. Apparatus for measuring movement shall comply with ASTM D3966. Provide equipment and personnel necessary to obtain the level observations required by the Contract Documents.
5. Protect load test set-up from inclement weather by tarpaulins and protective ditches and, if protection from freezing weather is necessary, provide temporary space heaters.

K. Static Load Test Reports:

1. Prepare reports for each test pile. Reports shall indicate results of load testing and include all field information required for pile driving reports under the Submittals Article of this Section.

L. Static Load Test Acceptance Criteria:
   1. Static tests shall be acceptable when results indicate compliance with acceptance criteria in the International Building Code, Section 1810.3.3.1.3, Load Test Evaluation Methods.

M. Engage an independent testing and inspection agency to inspect welded splices and to perform tests and prepare test reports.
   1. Testing agency shall conduct and interpret tests, prepare and state in each report of results whether test specimens comply with the Contract Documents and specifically state all deviations.
   2. Welded splices: Notify testing agency three days in advance of starting driving operations. Testing agency will be present on Site for the first day of driving operations to visually inspect field welded splices. Frequency and number of subsequent visits shall be determined by ENGINEER.
      a. Where visually-defective welds are evident, further test welds using non-destructive methods. If welds are determined to be acceptable, CONTRACTOR shall pay for non-destructive testing. When welds are defective, CONTRACTOR shall pay for non-destructive testing.
      b. Correct, or remove and replace, defective Work as directed by ENGINEER.
      c. CONTRACTOR shall pay for corrections and subsequent tests required to determine weld compliance with the Contract Documents.

N. Prior to pile driving, test the coating system for presence of holidays. Use low-voltage holiday detector of less than 90 volts in accordance with manufacturer's instructions.
   1. If holidays are detected, repair by surface treatment and application if additional paint in accordance with paint system manufacturer's recommendations. Retest coating after repair.
   2. After repair of holidays, measure dry film thickness using magnetic dry film thickness gauge in accordance with ASTM D7091 and ASTM E376.

END OF SECTION

SECTION 32 12 00

FLEXIBLE PAVING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install flexible, hot-mix, hot-laid, asphalt concrete pavement.
   2. The Work includes:
      a. Preparation such as saw cutting, milling where shown or indicated, cleaning, and other preparation for installing flexible pavements.
      b. Providing asphalt concrete paving materials.
      c. Providing tack coat material.
      d. Providing pavement markings where shown or indicated.
      e. Providing quality controls and testing.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before flexible paving Work.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AASHTO M320, Specification for Performance-Graded Asphalt Binder.
   2. AASHTO MP1a, Specification for Performance-Graded Asphalt Binder.
   3. AI MS-2, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.
   4. ASTM C1371, Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
   5. ASTM C1549, Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
   6. ASTM D242/D242M, Specification for Mineral Filler For Bituminous Paving Mixtures.
   7. ASTM D692/D692M, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
   8. ASTM D946/D946M, Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
   9. ASTM D977, Specification for Emulsified Asphalt.
   10. ASTM D1073, Specification for Fine Aggregate for Bituminous Paving Mixtures.
   11. ASTM D1188, Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.
   12. ASTM D2726, Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
   13. ASTM D2950, Test Method for Density of Bituminous Concrete in Place by Nuclear Methods.
   14. ASTM D3549, Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens.

15. ASTM D6690, Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
16. ASTM E329, Specification for Agencies Engaged in Construction Inspection and/or Testing.
17. ASTM E408, Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
18. ASTM E1918, Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
19. ASTM E1980, Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
20. FS TT-P-115, Paint, Traffic, Highway, White and Yellow.
21. South Carolina Department of Transportation (SCDOT) Qualified Products Listings for Construction and Maintenance Materials.
22. South Carolina Department of Transportation Standard Specifications for Highway Construction.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Asphalt Concrete Production Facility:
      a. Production facility for asphalt concrete, tack coat materials, and other bitumastic materials shall be certified by the SCDOT for furnishing such materials for SCDOT highways.
   2. CONTRACTOR’s Testing Laboratory:
      a. Retain the services of independent testing laboratory to perform testing and determine compliance with the Contract Documents of the materials provided under this Section.
      b. Do not employ the same laboratory hired by OWNER for field quality control testing under the “Field Quality Control” Article of this Section.
      c. Testing laboratory shall comply with ASTM E329 and requirements of Section 01 45 29, Testing Laboratory Services.
      d. Testing laboratory shall be experienced in the types of testing required.
      e. Selection of testing laboratory is subject to ENGINEER's acceptance.

B. Regulatory Requirements:
   1. Reference Specifications and Details:
      a. Comply with applicable requirements of SCDOT Standard Specifications for Highway Construction or other Authorities Having Jurisdiction where the Work takes place.
   2. Obtain required highway and street rights-of-way work permits.
   3. Jurisdiction:
      a. Paved areas to be constructed are jurisdiction of OWNER or SCDOT.

C. Quality Assurance Testing:
   1. Quality assurance testing is in addition to source quality control testing, when required, and field quality control testing required under Article 3.4 of this Section.
   2. Materials used in the Work may require testing and retesting, as directed by ENGINEER, during the Project. Allow free access to material stockpiles and facilities at all times. Tests not specifically indicated to be performed at OWNER's expense, including retesting of rejected materials and installed Work, shall be performed at CONTRACTOR’s expense.
   3. CONTRACTOR’s Quality Assurance Testing Laboratory Scope:
      a. Use of testing laboratory shall not relieve CONTRACTOR of responsibility for providing materials and the Work in compliance with the Contract Documents.

b. Quality assurance testing laboratory shall perform the following, unless evidence of material compliance with reference specifications indicated in Paragraph 1.3.B of this Section, is submitted to ENGINEER by CONTRACTOR and asphalt concrete production facility:
   1) Test in accordance with reference specifications indicated in Article 1.3 of this Section. In lieu of quality assurance testing submit evidence and certification of material compliance with reference specifications. When evidence of conformance submitted is not acceptable to ENGINEER, perform quality assurance testing.

c. To facilitate testing services, CONTRACTOR shall:
   1) Secure and deliver to testing laboratory and ENGINEER (when requested by ENGINEER) representative Samples of materials that CONTRACTOR proposes to furnish and that are required to be tested.
   2) Furnish such labor as is necessary to obtain and handle Samples at the Site or at asphalt concrete production facility and other material sources.
   3) Advise testing laboratory and ENGINEER sufficiently in advance of operations to allow for completion of quality assurance tests and for the assignment of personnel.

1.4 SUBMITTALS

A. The Submittals required in 1.4.B and 1.4.C apply to non-SCDOT work. Any work involving SCDOT roads are subject to SCDOT submittal procedures.

B. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit the proposed asphalt concrete mix design for each asphalt concrete material, and other bituminous materials, required under this Section, providing complete data on materials, including location in the Work, source, material content and percentages, temperatures and all other pertinent data. Indicate proportion of bituminous material from reclaimed asphalt pavement.
      b. Proposed gradation for each aggregate to be used in flexible paving. Submit gradation test results for the same material furnished on a previous project. Indicate the proportion of reclaimed asphalt pavement.
      c. In lieu of the information required under Paragraphs 1.4.B.1.a and 1.4.B.1.b, above, submit certificates of compliance with the reference specifications indicated in Part I of this Section, for each for the following:
         1) Each mix design required.
         2) Bituminous materials required.
         3) Aggregates to be used in flexible paving, from each material source and each required gradation.
         4) Density of uncompacted asphalt concrete material.
         5) Density of previously-compacted, previously-tested asphalt concrete material.
         6) Density and voids analysis for each asphalt concrete material test specimen.
         7) Evidence of asphalt concrete plant inspection and compliance with the reference specifications indicated in Part I of this Section.
         8) Proportion of reclaimed asphalt pavement in bituminous materials and aggregate.
   2. Product Data:
      a. Manufacturer's complete product data on all pavement marking materials proposed for use, including product literature, specifications, and recommended application techniques and other installation data.

C. Informational Submittals: Submit the following:
   1. Quality Assurance Test Data Submittals and Source Quality Control Submittals:
      a. Submit for quality assurance tests and source quality control tests required.
   2. Delivery Tickets:
      a. Submit copy of delivery ticket for each load of asphalt concrete, tack coat materials, and other materials obtained from asphalt concrete production facility, signed by CONTRACTOR
   3. Field Quality Control Submittals:
      a. Submit results of required field quality control testing.
   4. Qualifications:
      a. Asphalt concrete production facility, when required by ENGINEER.
      b. CONTRACTOR's testing laboratory, when required by ENGINEER.

1.5 SITE CONDITIONS

A. Weather Limitations:
   1. Temperature:
      a. For base course and binder course paving lifts equal to or greater than two inches thickness, atmospheric temperature shall be 40 degrees F and rising.
      b. For surface course paving or other pavement courses in lifts less than two inches thick, temperature of surface on which pavement is to be placed shall be 50 degrees F or greater.
   2. Prohibitions:
      a. Do not place flexible paving materials when weather is foggy or during precipitation.
      b. Do not place flexible paving materials when the base on which the material will be placed contains moisture in excess of optimum.
      c. Place flexible paving materials only when ENGINEER concurs that weather conditions are suitable.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. System Description:
   1. Provide subbase course of the thickness shown on the Drawings, in accordance with Section 31 23 05, Excavation and Fill.

2.2 ASPHALT CONCRETE MIXES

A. Asphalt Concrete Mixtures: Provide the following materials designed and manufactured in accordance with reference specifications indicated in Part I of this Section:
   1. Base Course: Comply with Section 309 of SCDOT Standard Specifications for Highway Construction.
   2. Binder Course: Comply with Section 402 of SCDOT Standard Specifications for Highway Construction and obtain from sources listed on the most recent edition of SCDOT Qualified Products List 37.
   3. Surface Course (Wearing Course, Top Course): Comply with Section 403 of SCDOT Standard Specifications for Highway Construction.

2.3 BITUMINOUS MATERIALS

A. Bituminous Materials for Asphalt Concrete:
   1. Bituminous materials for asphalt concrete shall comply with Section 401 of the SCDOT Standard Specifications for Highway Construction, for the asphalt concrete mixes specified.

2.4 AGGREGATES IN FLEXIBLE PAVEMENTS

A. Aggregates for Asphalt Concrete – General:
   1. Aggregate materials used in flexible pavement shall be in accordance with Section 401 of the SCDOT Standard Specifications for Highway Construction, for the asphalt concrete mix designs indicated.

2.5 PAVEMENT MARKING MATERIALS

A. Material: Pavement marking materials shall be in accordance with Section 625 for fast dry waterborne paint markings, Section 626 for epoxy pavement markings, and Section 627 of the SCDOT Standard Specifications for Highway Construction for thermoplastic pavement markings.

B. Colors:
   1. Roadway Center Markings Between Opposing Traffic Lanes: Yellow.
   2. Roadway Side Striping: White, unless otherwise shown or specified. On roads with divided median, right-side striping of each direction shall be white, and left-side striping shall be yellow.
   3. Roadway Miscellaneous Lane Markings (turn lane arrows and text): White.
   4. No-Parking Areas: Yellow.
   5. Handicap Parking Spaces: Unless otherwise indicated with signs, provide handicap symbol on pavement with white paint on blue background.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the subbase and base on which flexible paving will be installed. Notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

B. Do not place materials on subgrades, or subbase that is muddy or has water thereon.

3.2 PREPARATION

A. Preparation: Before starting installation of flexible paving, perform the following:
   1. Grade Control: Establish and maintain throughout flexible paving installation the required lines and grades, including crown and cross-slope for each asphalt concrete course during construction operations.

2. Prepare subgrade and provide subbase for flexible pavement in accordance with Section 31 23 05, Excavation and Fill. Before installing flexible pavement, obtain ENGINEER's concurrence that subgrade and subbase are suitable for installing flexible pavement.
3. Coordinate placement of flexible pavement with York County Ordinance No. 154 and the Work including drainage structures, manholes, valve boxes, and similar items.
4. Provide appropriate maintenance and protection of traffic measures during placement of pavement.

B. Milling:
1. Perform milling of existing pavement where shown or indicated.
2. "Milling" consists of the milling, shaping, and removing portions of existing surfaces by cold milling process and subsequent cleaning.
3. Milling Equipment:
   a. Milling machines shall be power-operated, self-propelled machines capable of removing the desired thickness of existing surfaces. Machines shall have sufficient power, traction, and stability to accurately maintain depth of cut and slope. Machines shall produce a finished profile and cross slope to within 1/4 inch of that required and shall produce uniform surface texture free of gouges and ridges greater than 3/8-inch deep.
   b. Machines shall be equipped with a means to control dust and other particulate matter created by the cutting action.
   c. Provide equipment that removes milled material as quickly as the rate of milling.
   d. Use vacuum trucks, street sweepers or power brooms to clean milled surfaces.
4. Milling Operations:
   a. Perform milling to so that, when final course of pavement is placed, required elevations and grades are provided. Where required, establish a taut reference string line to control line and grade of milling.
   b. Minimize the time between milling and placement of pavement over milled surface.
   c. Areas not accessible to the milling machine, such as around or adjacent to drainage structures, manholes, curbs, and transverse joints on structures, may be removed by a small milling machine, handwork or other method acceptable to ENGINEER.
   d. Remove milled material as soon as it is milled. Remove fines and other material prior to opening milled area to traffic. Control objectionable dust emissions. When traffic has been allowed into milled area or when more than 48 hours have elapsed since milling, clean the milled area again prior to applying tack coat.
   e. Maintain drainage to drainage inlets and other drainage structures in a manner acceptable to ENGINEER.
   f. Properly dispose of milled material at a location away from the Site.

C. Surface Preparation:
1. Repair surface defects in existing pavement to provide uniform surface to receive new pavement.
2. Provide crack sealant to completely fill cracks more than 1/16-inch wide in areas shown or indicated on the Drawings.
3. Clean existing surfaces over which asphalt concrete pavement will be installed, by removing from the surface foreign material, excess asphalt concrete, excess joint sealant, and crack filler, and other undesirable matter.
4. Provide tack coat as indicated in Part 3 of this Section.

3.3 INSTALLATION OF FLEXIBLE PAVING

A. General:
   1. Provide final pavement surfaces of uniform texture, at required grades and cross-sections.
   2. Construct roadways to the lines, grades, and typical sections shown or indicated.

B. Installation of Asphalt Concrete:
   1. Asphalt concrete mixture shall be transported to the site of paving and placed as soon as possible after mixing.
   2. Placement of each asphalt concrete course shall be completed over the full width of the section under construction during each day's paving operations.
   3. Spread and finish asphalt concrete courses by means of self-propelled mechanical spreading and finishing equipment. Compacted thickness of layers placed shall not exceed 150 percent of specified thickness unless approved in writing by ENGINEER.
   4. Compaction:
      a. Rollers:
         1) Use sufficient rolling equipment to satisfactorily compact and finish the quantity of asphalt concrete placed. There shall be not less than two rollers on the Project at all times. When acceptable to ENGINEER, one of the rollers may be a pneumatic-tire roller.
         2) During rolling operations, roller speed shall not exceed three miles per hour. When sufficient number of rollers is not available, reduce the quantity of asphalt concrete placed to accommodate the available rollers' speed.
         3) Required rollers shall be at the Site, in acceptable operating condition, prior to placing of asphalt concrete.
         4) Use of vibratory rollers in lieu of steel-wheeled rollers is acceptable, however when thickness of asphalt concrete is one-inch or less, rolling shall be in the static mode.
      b. Rolling of initially-placed asphalt concrete material, or breakdown rolling, shall begin as soon as the asphalt concrete mixture will bear the roller without undue displacement.
      c. Rolling shall be longitudinal, overlapping on successive trips by not less than one-half roller rear wheel width, and not more than three-quarters of roller rear wheel width. Alternate trips of the roller shall be of slightly different lengths.
      d. At all times, roller motion shall be slow enough to avoid displacing the asphalt concrete.
      e. Operate rollers continuously from breakdown of laid asphalt concrete through finish rolling.
      f. Perform finish rolling using a steel-wheeled roller or a vibratory steel-wheel roller operating in the static mode.
      g. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
      h. At each location not accessible to roller, thoroughly compact asphalt concrete with tampers and finish, where necessary, with a hot smoothing iron to provide uniform, smooth layer over the entire area so compacted.
   5. Each compacted asphalt concrete course shall be within plus or minus 1/4-inch of the indicated thickness.
   6. Placement of Adjacent Strips of New Asphalt Concrete:
      a. When more than one width of asphalt concrete material will be placed, a six-inch wide strip of asphalt concrete adjacent to the area on which the future material is to be placed shall not be rolled until such future material is placed.
      b. Do not leave the unrolled strip unrolled for more than two hours after placement, unless the six-inch unrolled strip is first heated with a joint heater.

c. After the first strip or width of asphalt concrete is compacted, place, finish, and compact the second width or strip as required for the first width, except that rolling shall be extended to include the six-inch strip of the first width not previously compacted.

C. Construction Joints:
1. Construction joints shall be made in such a manner as to ensure a neat junction, thorough compaction, and bond throughout.
2. Provide a transverse joint extending over the full width of the strip being laid and at right angles to its centerline at end of each workday and at other times when the placement of hot-mix asphalt concrete will be suspended for a period of time that will allow asphalt concrete mixture to chill.
3. Thoroughly compact by rolling the forward end of a freshly laid strip of asphalt concrete before the asphalt concrete mixture becomes chilled. When the Work is resumed, the end shall be cut vertically for the full depth of the layer.

D. Joining of Pavements:
1. When pavement is to join existing or previously-laid pavement, the existing or previously-laid pavement shall be neatly and carefully edged to allow for overlapping and feathering of the subsequent course of asphalt concrete material.
2. Where new pavement is to meet existing pavement, the existing pavement shall be sawcut and notched.
3. Where new pavement will meet existing asphalt pavement, remove existing pavement 12 inches onto undisturbed existing pavement course at edges where new pavement will meet existing pavement.
4. Tack Coat:
a. Provide tack coat material at the following locations:
1) At edges where new pavement will connect to existing or previously-installed pavement.
2) On surface of existing or previously-installed pavement course over which new pavement will be installed, prior to placement of the subsequent pavement course. Tack coat may be deleted when a succeeding layer of asphalt pavement is being applied over a freshly-placed asphalt pavement course that has been subjected to very little or no traffic, with approval of ENGINEER
3) Where new pavement will abut curbing, concrete gutters, drainage structures and frames, manhole cover frames, valve boxes, and similar items.
b. Tack Coat Installation: Install tack coat immediately prior to installing pavement. Place pavement while tack coat is wet. Apply tack coat in accordance with reference specifications indicated in Part I of this Section.

E. Curing:
1. Do not allow traffic onto pavement until directed by ENGINEER. Traffic will not be allowed on new asphalt concrete pavement until surface temperature is less than 140 degrees F.
2. Hold construction traffic on new pavement to a minimum as acceptable to ENGINEER.

F. Asphalt Concrete Curbs: Provide extruded asphalt curbs of the height and profile indicated on the Drawings.

G. Defective Pavement Work:

1. When directed by ENGINEER, remove and replace defective flexible paving Work. Cut out such areas of defective pavement and fill with fresh asphalt concrete materials, compacted to required density.

3.4 ADJUSTING

A. Frames and Covers:
   1. Set frames of drainage structures, manholes, valve boxes, and similar items to final grade. Adjust frames of existing structures and frames furnished under other Sections. Frames shall be substantially similar elevation to finished surface course of pavement.
   2. Replace covers and gratings of existing structures immediately following adjusting associated frames. Install covers and gratings of structures provided under the Project as quickly as possible.
   3. Where there is a delay between adjusting of frames and installation of surface course, provide temporary bituminous material around perimeter of each frame to smooth vehicle access over the frame. Maintain and repair temporary bituminous material as required until placement of surface course. Remove temporary bituminous material before installing surface course.

B. Pavement Adjustment:
   1. Repair or replace in manner acceptable to ENGINEER areas of pavement that are observed to pond or collect water.

3.5 CLEANING

A. Cleaning: After completing the paving operations, clean surfaces of excess or spilled bituminous materials, excess asphalt concrete, and foreign matter.

3.6 PROTECTION

A. Protect finished pavement until pavement has become properly hardened and cool.

B. Cover openings of drainage structures, manholes, valve boxes, and similar items in the paved area until permanent coverings are provided.

3.7 PAVEMENT MARKINGS

A. Pavement Markings: Provide pavement markings where shown or indicated.
   1. Preparation:
      a. Sweep surface with power broom supplemented by hand brooms to remove loose material and dirt.
      b. Do not begin marking bituminous concrete pavement until approved by ENGINEER.
      c. When reflective glass beads are required, mix with paint prior to paint application.
   2. Application:
      a. Using mechanical equipment, provide uniform, straight edges in two separate coats. Apply in accordance with paint manufacturer's recommendations.

END OF SECTION

SECTION 32 92 00

LAWNS AND MEADOWS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, tools, equipment and incidentals as shown, specified and required to furnish and install all lawns and meadows.
   2. Extent of lawns and meadows is shown.
   3. Types of products required include the following.
      a. Topsoil.
      b. Lawn grass seed.
      c. Meadow grass seed mixture.
      d. Wildflower meadow seed mixture.
      e. Inorganic soil amendments.
      f. Organic soil amendments.
      g. Fertilizers.
      h. Mulches.
      i. Erosion-control materials.
      j. Accessories.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with, or before, lawns and meadows.

C. Related Sections:
   1. Section 31 11 00, Clearing and Grubbing.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. Association of Official Analytic Chemists, (AOAC).
      a. Official Methods of Analysis of AOAC International.
   2. Association of Official Seed Analysts, (AOSA).
      a. Journal of Seed Technology; Rules for Testing Seeds.
   3. American Society of Agronomy, (ASA).
      a. Reference No. 1 - Methods of Soils Analysis, Soil Science Society of America, Incorporated.
   4. American Society for Testing and Materials, (ASTM).
      a. ASTM B 221, Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
      b. ASTM C 602, Specification for Agricultural Liming Materials.
      c. ASTM D 75, Practice for Sampling Aggregates.
      d. ASTM D 977, Specification for Emulsified Asphalt.
      e. ASTM D 2487, Practice for Classification of Soils for Engineering Purposes (United Soil Classification System).
      f. ASTM D 5268, Specification for Topsoil Used for Landscape Purposes.

g. ASTM E 329, Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

5. South Carolina Department of Transportation (SCDOT).
   a. Qualified Products List 88.
   b. Supplemental Technical Specification SC-M-810-4.
6. South Carolina Department of Health and Environmental Control (SCDHEC) Storm Water Management BMP Handbook, Appendix C.

1.3 DEFINITIONS

A. The term “finish grade” shall be used to describe the finished surface elevation of planting soil.

B. The term “manufactured topsoil” shall be used to describe soil produced off-Site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil acceptable as a component of loam.

C. The term “loam” shall be used to describe topsoil that has been mixed with additional organic and inorganic additives, as specified.

D. The term “percentage pure live seed” shall be defined as the percent (%) purity multiplied by percent (%) germination divided by 100 to equal the percent pure live seed (PLS) and shall be calculated for all seed lots using each seed lots own unique purity and germination test results. A PLS pound shall be defined as the bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.

E. The term “subgrade” shall be used to describe the surface of subsoil remaining after completing excavation; or the top surface of a fill or backfill immediately beneath topsoil and which has not been tested for acceptable use as topsoil.

1.4 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Engage a single landscape installer skilled, trained and with successful and documented experience in the planting of lawns and meadows and with specific skill and successful experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and successful experience in this type of Work. Submit names and qualifications to ENGINEER along with the following information on a minimum of three successful projects:
      a. Names and telephone numbers of owner, architects or engineers responsible for projects.
      b. Approximate contract cost of the lawns and meadows.
      c. Amount of area installed.
   2. Installer’s Site Supervisor: Require installer to maintain an experienced full-time landscape supervisor on-Site during the time of preparation for, and planting of, lawns and meadows. Supervisor shall have achieved landscape or horticultural certification acceptable to governing authorities having jurisdiction at the Site.
   3. Ratio of laborers to certified landscape supervisors shall not exceed 12 to one. Certified landscape supervisor shall be on-Site throughout the day-to-day performance of the Work of this Section.

4. Application of herbicides, chemicals and insecticides shall be done by personnel licensed to perform such applications by governing authorities having jurisdiction at the Site and in accordance with each manufacturer's instructions provided on each product label.

B. Soil-Testing Laboratory Qualifications:
   1. An independent laboratory, recognized by governing authorities having jurisdiction at the Site, with the experience and capability to conduct testing indicated and that specializes in types of soil tests to be performed.
   2. To qualify for approval, an independent testing agency shall demonstrate to ENGINEER'S satisfaction, based on evaluation of criteria submitted by testing agency, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work, in accordance with ASTM E 329.

C. References: Comply with the applicable references in Article 1.2.

D. Soil Analysis: Furnish report of soil analysis to ENGINEER, prepared by a qualified soil-testing laboratory, stating percentages of organic matter; mechanical gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious materials content; pH; and mineral and plant-nutrient content of soil. Chemical analysis shall include tests for percentages of nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, iron, manganese, copper, zinc, extractable aluminum, and total soluble salts.
   1. Existing On-Site Soil:
      a. Separate soil stockpiled and proposed for use as topsoil for lawns and meadows into 1000 cubic yard piles and label with a numbering system used to reference all soil samples and test results.
      b. Obtain a one cubic foot representative sample for each 1000 cubic yards of soil stockpiled on-Site proposed for use as topsoil for lawns and meadows, in compliance with ASTM D 75 and Appendixes, for securing samples from stockpiles.
      c. Place samples taken from each stockpile, into separate clean, new and previously unused, containers and mix thoroughly. Maintain separation and legible labeling of each sample taken from each stockpile, throughout the process of mixing, drying and delivering to soil analysis laboratory. Label samples on outside of container.
      d. Take one cup of soil from each container and allow to dry at room temperature. Once dry, place each one-cup sample in a separate, accurately labeled, new and previously unused one-cup sized plastic container, seal tightly and deliver to soil testing laboratory.
      e. Report suitability of soil as a topsoil component for lawn and meadow plant growth. State recommended quantities of nitrogen, phosphorus, secondary and micronutrients, potash and soil amendments to be added to produce satisfactory topsoils. Include calculations, types of fertilizer and recommendations for application rates in either gallons or pounds per cubic foot of soil.
      f. In addition, all on-Site soil that will be used as topsoil shall be provided with additional compost and peat moss amendments specified, whether or not testing indicates positive need for such amendments, for such material to be used as loam.
   2. Manufactured Imported Topsoil:

a. Test each 1000 cubic yards of manufactured topsoil at the proposed source. In addition, after ENGINEER'S approval of manufactured topsoil based on results and recommendations of soil testing reports, test each 1000 cubic yards of manufactured topsoil that is delivered to the Site for conformance to results and recommended modifications of approved soil test reports. Manufactured topsoil that differs from proposed source material, after modification according to recommendations of soil test reports, shall be rejected for use in the Work.
b. Obtain a one cubic foot representative sample for each 1000 cubic yards of manufactured topsoil proposed for lawn and meadow Work, in compliance with ASTM D 75 and Appendixes, for securing samples from stockpiles.
c. Place samples taken from each stockpile into separate clean, new and previously unused, containers and mix thoroughly. Maintain separation and legible labeling of each sample, taken from each stockpile, throughout the process of mixing, drying and delivering to soil analysis laboratory. Label samples on outside of container.
d. Take one cup of topsoil from each container and allow to dry at room temperature. Once dry, place each one-cup sample in a separate, accurately labeled, new and previously unused one-cup sized plastic container, seal tightly and deliver to soil testing laboratory.
e. Report suitability of manufactured topsoil as a component for lawn and meadow plant growth. State recommended quantities of nitrogen, phosphorus, secondary and micronutrients, potash and soil amendments to be added to produce satisfactory manufactured topsoil. Include calculations, types of fertilizer and recommendations for application rates in either gallons or pounds per cubic foot of manufactured topsoil.
f. Organic component of manufactured topsoil shall be obtained from compost and peat moss amendments specified, for such material to be used as loam.

E. Source Quality Control:
1. Analysis and Standards: Package all products with manufacturer's certified analysis performed in accordance with methods established by AOAC, wherever applicable, or as specified.
2. Provide manufactured imported topsoil from a commercial processing facility specializing in the manufacture of topsoil.
3. Seed that has been stored at temperatures, or under conditions not recommended by the seed supplier, or has become wet, moldy, or otherwise damaged, shall not be acceptable. The PLS for each seed lot shall be 75 percent, minimum.
4. Certify that all seed has been stored under conditions recommended by the seed supplier and has not been subjected to conditions damaging to PLS percentages.
5. Seed may be mixed by an approved method on-Site or at the seed supplier's facilities. If the seed is mixed on-Site, each variety shall be delivered in the original containers and shall bear the supplier's certified analysis. Where seed is mixed by the seed supplier, provide ENGINEER with the seed supplier's certified statement as to the composition of the mixture.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Schedule for lawn and meadow-planting showing anticipated planting dates for each type of Work.

2. Product Data:
    a. Manufacturer's product data, specifications and installation instructions for all required materials.
    b. Composition and analysis of commercial fertilizers and all purchase receipts showing the total quantity actually purchased for this Project.
    c. Proportions of each component contained in hydro seed mixture. Identify number of pounds of each component required for each 100 gallons of water. Include the number of square feet of lawn, grass meadow or wildflower meadow mixture that can be installed with each full tank of hydro seed mixture.
    d. PLS for each type of seed and each seed lot. Include bulk weight of seed required to equal one pound of 100 percent pure, germinated seed.
3. Samples:
    a. Submit 12-inch by 12-inch sheet of erosion control fabric with manufacturer's selections of standard biodegradable filler papers, and yarns.

B. Informational Submittals: Submit the following:
1. Certificates:
    a. Certification of Grass and Wildflower Seed: For each grass-seed monostand and seed mixture, furnish seed supplier's certification stating the botanical and common name, and percentage by weight of each species and variety, and percentage of purity, germination and weed seed. Include the year of production and date of packaging. Certify that seed has been stored in compliance with all recommendations of the seed supplier.
    b. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's certified analysis for soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
2. Test Reports: Submit the following:
    a. Soil analysis reports for existing soil and imported manufactured topsoil, as specified. Include recommendations for remediating existing soil into acceptable topsoil.
3. Qualifications Data: Submit qualifications data for the following:
    a. Landscape installer.
    b. Landscape supervisor.
    c. Testing agency.
4. Source Quality Control Submittals
    a. Written statement providing the location from which manufactured topsoil is to be obtained and the names and addresses of the suppliers.

C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data:
    a. Submit recommended procedures to be established by OWNER for the maintenance of lawns and meadows for one full year. Submit prior to expiration of required maintenance period.
2. Warranty Documentation:
    a. Submit written warranty, signed by CONTRACTOR and landscape installer, as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials:
   1. Do not deliver seed until Site conditions are ready for installation.
   2. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery.
   3. Deliver seed in undamaged, original containers, sealed by the supplier and indicating compliance with approved Shop Drawings.
   4. Inspect lawn and meadow materials upon arrival at Site. Immediately and permanently remove unacceptable materials from Site.

B. Storage of Materials:
   1. Store and cover materials to prevent deterioration. Remove packaged materials that become wet or show deterioration or water marks from the Site.
   2. Seed that becomes wet, moldy or damaged during the time of storage on-Site or that has been damaged during transit is not acceptable.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Proceed with and complete lawn and meadow planting as rapidly as portions of the Site become available, working within the seasonal limitations for each type of lawn, grass and wildflower planting required.
   2. Proceed with planting only when current and forecasted weather conditions are favorable to successful planting and establishment of lawns and meadows.
      a. Do not spread seed when wind velocity exceeds five miles per hour.
      b. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.
   3. Herbicides, chemicals and insecticides shall not be used on areas bordering wetlands.

B. Scheduling:
   1. Coordinate planting with specified extended service periods to provide required service from date of Substantial Completion. Plant during one of the following periods:
      a. Permanent Seeding:
         1) Comply with recommendations of supplier.
      b. Temporary Seeding:
         1) Comply with recommendations of supplier.
   2. Do not begin lawn and meadow planting until water, acceptable for use and adequate in supply, is available on-Site and can be successfully transported to the areas of Work. Coordinate provision of adequate and acceptable water supply with Project Schedule.
   3. Do not proceed with installation of loam until all subgrade utility services have been installed, are operating successfully and have been approved by ENGINEER.

C. Pre-installation Conference:
   1. Prior to commencement of lawn and meadow planting and associated Work, CONTRACTOR shall schedule and meet at the Site with the landscape installer, the installers of other Work in and around lawn and meadow areas that follows the lawn and meadow Work, including fencing Work; and ENGINEER and other representatives directly concerned with performance of the Work. Review foreseeable methods and procedures related to the lawn and meadow Work, including the following:
      a. Review Project requirements and the Contract Documents.

b. Review required submittals, both completed and yet to be completed.
c. Review availability of water and methods of delivery.
d. Review status of below-grade work and required access during lawn and meadow planting and establishment.
e. Review Project Schedule and availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
f. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
g. Review procedures required for protection of lawns and meadows during the remainder of the construction period.
h. Review required inspection, testing, and certifying procedures.

2. Record the discussions of the Pre-installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the record to each party attending.
3. Record all revisions or changes agreed upon, reasons therefor, and parties agreeing or disagreeing with them.
4. Reconvene the meeting at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

1.8 WARRANTY

A. General Warranty: The special warranties specified in this Article shall not deprive OWNER of other rights or remedies OWNER may otherwise have under the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by CONTRACTOR under the Contract Documents.

B. Special Warranties: Warranty lawns and meadows through the specified extended service period.

1.9 EXTENDED SERVICE

A. Extended Lawn Service:
1. Begin extended service immediately after each lawn area is acceptably established. Provide extended service for not less than the following periods:
2. Seeded Lawns: Sixty days from date after lawn areas are acceptably established.
a. When full service period has not elapsed before end of planting season, or if lawn is not acceptably established, continue service during next planting season.
3. Service lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.
a. In areas where mulch has been disturbed by wind or extended service operations, add new mulch. Anchor as required to prevent displacement.
4. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources. Keep newly germinated plants uniformly moist to a depth of 4-inches, applied at a minimum rate of 1-inch per week, or greater as required to maintain minimum moisture depth specified. Provide and maintain watering gages and soil moisture probes until end of maintenance period.
a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

b. After plants have their first true leaves and grasses show mature blades, watering shall be performed to provide moisture to a depth of 6-inches, and not performed again until top 1-inch of loam has dried.

5. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 40 percent of grass-leaf height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowing to maintain the following grass height:
   a. Bent Grass: Mow to 1/2-inch high or less.
   b. Bermuda Grass: Mow 1/2 to 1-inch high.
   c. Carpet, Centipede, Perennial Rye and Zoysia Grasses: Mow 1 to 2-inches high.
   d. Kentucky Bluegrass and Buffalo, Annual Rye and Chewings Red Fescue Grasses: Mow 1-1/2 to 2-inches high.
   e. Bahia, Turf-Type Tall Fescue and St. Augustine Grasses: Mow 2 to 3-inches high.
6. Lawn Fertilization: Apply fertilizer after initial mowing and when grass is dry.
   a. Use fertilizer that will provide actual nitrogen of at least one pound for each 1000 square feet of lawn area.
7. After seed has passed its expected germination period, reseed all areas and parts of areas that fail to show a uniform stand of grass. Reseed repeatedly until all areas are covered with grass.

B. Extended Meadow Service:
1. Begin extended service immediately after each meadow area is satisfactorily established and continue for not less than 40 days.
2. Service meadow by watering, weeding, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch.
3. Watering: Provide and maintain temporary piping, hoses, and meadow- watering equipment to convey water from sources. Keep meadow uniformly moist to a depth of 6-inches. Provide and maintain watering gages and soil moisture probes until end of maintenance period.
   a. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
   b. Water meadow at a rate in accordance with supplier's written recommendations. Water at controlled rates that are less than the rate at which the soil can absorb water to prevent runoff.
   c. After plants have their first true leaves and grasses show mature blades, perform watering to provide moisture to a depth of 8-inches, and do not perform again until top 1-inch of loam has dried.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil:
1. All soil accepted as topsoil, whether obtained from on-Site or off-Site sources, shall comply with specified topsoil analysis.

2. Provide fertile, friable, natural loam, surface soil, capable of sustaining vigorous plant growth; free of any admixture of subsoil, clods of hard earth, plants or roots, sticks, stones larger than 1-inch in diameter, or other extraneous material harmful to plant growth, in compliance with ASTM D 5268. Provide topsoil with the following analysis:
    a. 3/4-inch mesh: 100 percent passing.
    b. No. 4-sieve: 90 to 100 percent passing.
    c. No. 200-sieve: 0 to 10 percent passing.
    d. Clay content of material passing No. 200-sieve not greater than 60 percent, as determined by hydrometer tests.
    e. pH-adjusted with ferrous sulphate or ground limestone to provide pH 5.5 to pH 7.0 at time of installation of lawns, grass and meadow areas, unless particular species of grass or wildflower stand requires a different pH to meet its growing needs.
    f. Electrical conductivity of a 1:2 soil-water suspension shall not exceed 1.0 milliohm per centimeter and with less than 200 parts per million of extractable aluminum.
    g. Cation Exchange Capacity: 5, minimum.
    h. Organic content not less than five percent, as determined by ignition loss of oven-dried samples passing No. 10-sieve (Muffle Furnace Temperature: 110 plus or minus five degrees C for eight hours).
    i. Free of pests and pest larvae.
3. Topsoil Source: Reuse surface soil stockpiled on-Site, where possible. Verify suitability of stockpiled surface soil to produce topsoil, as specified. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
    a. Supplement acceptable on-Site soil with manufactured topsoil from off-Site sources, when quantities available on-Site are insufficient to complete the Work.

B. Lawn Grass Seed:
1. Lawn Grass Seed Mixture: Provide fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of the grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, specified.
2. Seed Species: Provide seed in compliance with SCDHEC Storm Water Management BMP Handbook Appendix C for turf-type grasses.

C. Meadow Grass Seed:
1. Tall Grassy Meadow with Minor Forbs: Provide a mixture of fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of each species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed specified.
2. Seed Species: Provide seed in compliance with SCDHEC Storm Water Management BMP Handbook Appendix C .

D. Wildflower Meadow Seed:
1. Wildflower Meadow with Minor Grasses: Provide a mixture of fresh, clean, new-crop seed complying with the tolerance for purity and germination established by AOSA. Provide seed of each grass and forb species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed specified.
2. Seed Species: Seed of grass and forb species as follows, with not less than 80.0 percent germination, not less than 80 percent pure seed, and not more than 1.0 percent weed seed by weight:

a. Provide seed in compliance with Table 1 of SC-M-810-4 for legumes.

E. Inorganic Soil Amendments:
   1. Ground Oolitic Limestone: ASTM C 602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent and as follows:
      a. Class: Class T, with a minimum 99 percent passing through No. 8-sieve and a minimum 75 percent passing through No. 60-sieve.
   2. Perlite: Agricultural-grade, expanded pumice.
   3. Agricultural Gypsum: Commercial-grade and finely ground, containing a minimum of 90 percent calcium sulfate.
   4. Grit Aggregate: Commercial-grade filter sand consisting of hard, durable rounded grains of quartz or other rock that do not compact to a solid mass when wet, with a pH in the range required for topsoil. Provide clean, washed, natural or manufactured aggregate, free of toxic materials, salt and other chemical contamination.

F. Organic Soil Amendments:
   1. Compost: Well-composted, stable, weed-free organic matter, produced by the aerobic decomposition of organic residues; pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch screen; soluble salt content of 5 to 10 decisiemens/meter; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
      a. Organic Matter Content: 50 to 60 percent of dry weight.
      b. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
   2. Peat: Partially decomposed stems and leaves of several species of sphagnum moss; finely divided or granular texture. Supply shredded material, free from lumps, wood, roots, stones, decomposed collodial residue and other extraneous foreign matter, capable of passing through a 1/2-inch screen, which can easily be incorporated with the soil. Supply material, which has been conditioned in storage piles after excavation for at least six months, including one freezing and thawing period. Supply peat humus with the following analysis:
      a. Not less than 90 percent organic matter by weight on an ovendry basis.
      b. pH range of 3.4 to 4.8.
      c. Moisture content 35 percent at time of incorporation into soil.
      d. Water absorbing ability 150 percent to 350 percent by weight.
   3. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
   4. 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, and material harmful to plant growth.

G. Fertilizers:
   1. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of four percent nitrogen and 20 percent phosphoric acid.
   2. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
   3. 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:

a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports.

4. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   a. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

H. Mulches:
1. Straw Mulch: Provide air-dry, clean, mildew- and certified seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
2. Peat Mulch: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat and having a water-absorbing capacity of 1100 to 2000 percent.
3. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch screen; soluble salt content of 5 to 10 decisiemens/meter; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   a. Organic Matter Content: 50 to 60 percent of dry weight.
   b. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
4. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
5. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
6. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant- growth or germination inhibitors.

I. Erosion-Control Materials:
1. Erosion-Control Blankets: 100 percent biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended 6-inches long steel wire staples.
2. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 pounds per cubic yard, with 50 to 65 percent open area. Include manufacturer's recommended 6-inches long steel wire staples.

J. Accessories:
1. Provide herbicides, chemicals and insecticides as needed for disease, fungus or pest control. All herbicides, chemicals and insecticides shall be bear approval labels indicating they are approved by the United States Department of Agriculture for the intended uses and application rates.
2. Post Emergent Crab Grass and Plantain Chemical: Provide recommended post emergent crab grass and plantain control throughout the maintenance period to ensure germinated and established lawns free of crab grass and other undesirable grasses and forbs.
3. Wood Edging: Of sizes shown, and wood stakes as follows:
   a. Species: All Heart Redwood or Western Red Cedar, All Heart.
   b. Stakes: Same species as edging, 1-inch by 2-inches by 18-inches long in nominal size, with galvanized nails for anchoring edging.

4. Steel Edging: Standard commercial steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
    a. Edging Size: 1/4-inch wide by 5-inches deep.
    b. Stakes: Tapered steel, a minimum of 15-inches long.
    c. Accessories: Standard tapered ends, corners, and splicers.
    d. Finish: Zinc-coated.
    e. Paint Color: Black.
5. 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.
    a. Edging Size: 3/16-inches wide by 5-1/2-inches deep.
    b. Stakes: Aluminum, ASTM B 221, alloy 6061-T6, approximately 1-1/2- inches wide by 12-inches long.
    c. Finish: Black anodized.
6. Polyethylene Edging: Standard black polyethylene edging, V-lipped bottom horizontally grooved, extruded in standard lengths, with 9-inch steel angle stakes.
    a. Edging Size: 0.07-inch wide by 5-inches deep.
    b. Top Profile: Round top; 1/2-inch diameter.

K. Water: Acceptable for lawn and meadow application and containing no material harmful to plant growth and establishment.

2.2 LOAM MIXES

A. Follow recommendations of soil-testing laboratory for modifying on-Site soil and manufactured soil, for use as topsoil.

B. On-Site soil and manufactured soil that has been provided with all inorganic soil amendments and fertilizers recommended by soil-testing laboratory, and acceptable for use as topsoil, shall be mixed with an additional organic soil amendment mix in a ratio of two parts topsoil to one part organic soil amendment mix, by volume.
    1. Prepare soil amendment mix by combining 40 percent compost, 40 percent peat moss, ten percent wood derivatives, five percent well-rotted manure and five percent grit aggregate, by volume.

C. Loam: Thoroughly blend topsoil with organic soil amendment mix and use as planting media for all lawn and meadow Work.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which lawn and meadow Work is to be performed, and notify ENGINEER, in writing, of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.2 PREPARATION

A. Thoroughly blend and mix loam before spreading. Incorporate fertilizers, and ground limestone or acidulant, after spreading, as specified, and at rates recommended by soil-testing laboratory.

B. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding overspray.

C. Provide 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.

D. Perform percolation tests on existing subgrade and placed fills prior to fine grading.
   1. Perform percolation testing of subgrades and placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests in accordance with the following procedure:
      a. Dig a hole in the subgrade that is 4-inches in diameter and 12-inches deep.
      b. Fill the hole with water and wait for the water to completely drain from the hole.
      c. Immediately refill the hole with water and measure the rate of fall in the water level.
   2. In the event that water drains at a rate less than 1-inch in one hour, excavate soil to a minimum depth of 24-inches, and deeper, as necessary to break the compaction. Backfill, recompact and retest each area so prepared to confirm drainage rates exceed one inch in one hour.
   3. Perform minimum of one soil percolation test for every 10,000 square feet of lawn and meadow area.

E. Excavate or fill subgrade, as required, to bring subgrade to elevations shown. Maintain all angles of repose. Confirm that subgrade is at proper elevations and that no further earthwork is required to bring the subgrade to proper elevations. Provide subgrade elevations that slope parallel to finished grade and towards subsurface drains shown.

F. Remove all construction debris, trash, rubble and all extraneous materials from subgrade. In the event that fuels, oils, concrete washout or other material harmful to plant growth or germination have been spilled into the subgrade, excavate the subgrade sufficiently to remove all such harmful materials and fill with approved fill, compacted to the required subgrade compaction level.

3.3 FINE GRADING

A. Immediately prior to dumping and spreading loam, clean subgrade of all stones greater than 2-inches and all other extraneous matter. Remove all such material from Site. Notify ENGINEER that subgrade has been cleaned, and obtain approval prior to spreading loam.

B. Do not attempt to spread excessively wet, muddy or frozen loam. Do not spread loam more than five days before seeding or planting.

C. Spread loam to a depth of 6-inches but not less than required to meet finish grades after light rolling and natural settlement.
   1. Spread approximately one-half the thickness of required loam depth. After spreading loam, rototill, disk or harrow loam and subgrade to bring top 2-inches of subgrade upward into loam layer, so that there is a transitional layer between loam and subgrade.
   2. Spread remainder of loam to required finish grades.
   3. Compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through loam. After compaction spread loam should offer firm, even resistance when a soil sampling tube is inserted.
   4. Phase the placement of the final lift so that wheeled vehicles do not have to travel over areas where final lifts are already in-place.
   5. Spread and compact to a smooth, uniform surface plane, to within plus or minus 1/2-inch of finish elevations. Roll and rake and remove all ridges, and fill depressions, as required. Remove all stones larger than 1-inch in any dimension and all sticks, roots, trash and other extraneous matter.
   6. Perform percolation tests as for subgrades, except limit depth of holes to 2/3 the depth of loam layer.

D. Spread ground limestone or acidulant and fertilizer, as specified. Mix ground limestone with dry loam before spreading fertilizer and work lightly into the top 4-inches of loam by harrowing or tilling at least three days before applying commercial fertilizers.

E. Grade planting areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous material in excess of 1-inch diameter. Roll, rake and remove ridges and fill depressions, as required to meet finish grades.

F. Moisten prepared areas before seeding. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy loam condition.

G. Prior to seeding or planting, restore loam to specified condition, if eroded or otherwise disturbed.

3.4 CONVENTIONAL SEEDING

A. General: Maintain grade stakes until removal is mutually agreed upon by all parties concerned.

B. Rake or harrow all seedbeds immediately prior to seeding to produce a rough, grooved surface, no deeper than 1-inch. Seed only when seedbed is in a friable condition and not muddy or hard.

C. Sow seed using a spreader or seeding machine.

D. Distribute seed evenly over entire area by sowing equal quantity in two directions at right angles to each other.

E. Sow lawn grass seed mixture at the rate of not less than required by SCDHEC Storm Water Management BMP Handbook Appendix C .

F. Sow meadow grass with minor forbs seed mixture at the rate of not less than required by SCDHEC Storm Water Management BMP Handbook Appendix C.

G. Sow wildflower meadow with minor grasses seed mixture at the rate of not less than 19-pounds per acre.

H. Cultipacker, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultipacker:
   1. Rake the seed lightly into top 1/8-inch of loam, roll in two directions with a water ballast roller, weighing not less than 100 pounds per linear foot.
   2. Take care during raking that seed is not raked from one spot to another.
   3. Protect seeded areas against erosion by spreading specified mulch after completion of seeding operations.
      a. Protect seeded areas against hot, dry weather or drying winds by applying peat moss mulch not more than 24 hours after completion of seeding operations. Presoak and scatter evenly to a depth of from 1/8-inch to 3/16-inches thick and roll to a smooth surface. Do not mound.
      b. For slopes no steeper than one on six, spread straw mulch to form a continuous loose blanket not less than 1-1/2-inch deep over seeded areas at the approximately rate of two tons-per acre.
         1) Anchor mulch by spraying with asphalt emulsion at the rate of ten to 13-gallons per 1000 square feet.
         2) Place mulch with equipment that will blow or eject, by means of a constant air stream, controlled quantities of the mulch and asphalt in a uniform pattern over the specified area. If the mulch is excessively cut or broken, take measures to reduce the cutting or breakage. Introduce the asphalt into the air stream by means of a spray arranged so that it will partially coat the mulch with a spotty asphalt tack prior to the depositing of the mulch covering. Rate of application not less than 75-gallons per ton of mulch.
      c. Protect seeded areas, with slopes exceeding one on six, by providing erosion-control fiber mesh and where slopes exceed one on four, by providing erosion-control blankets. Install erosion-control materials according to manufacturer's written instructions and as follows:
         1) Vertically down slope without stretching fabric.
         2) Install hold down staples three per square yard minimum in center of fabric or as required to hold and shape the fabric to the contours of the slope. Install hold down staples along edges and overlaps of fabric at 9 inches on centers minimum, or as required to hold and shape the fabric to the contours of the slope.
         3) Lap fabric 4-inches minimum and turn edges of fabric into 8-inch deep by 16-inch wide earth trench and fill trench with earth.

I. Using a uniform fine spray, thoroughly and evenly water seeded areas. Provide adequate water to moisten seedbed to a depth of 2-inches.
   1. Repeat this process when peat mulch color lightens. Maintain all seedbeds in a uniformly moist condition, conducive to seed germination and plant establishment, as specified.

J. Reseed areas that remain without mulch for longer than three days.

K. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

L. Prevent foot or vehicular traffic, or the movement of equipment, over the mulched areas. Reseed areas damaged as a result of such activity.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

B. Mix slurry with asphalt-emulsion tackifier.

C. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at a minimum rate of 500-pounds per acre dry weight, but not less than the rate required to obtain specified seed-sowing rate so that the seed comes into direct contact with loam.

D. Apply slurry cover coat of fiber mulch at a rate of 1000-pounds per acre.

3.6 RECONDITIONING EXISTING LAWNS AND MEADOWS

A. Recondition existing lawn and meadow damaged by CONTRACTOR'S operations, including areas used for storage of materials or equipment and areas damaged by movement of vehicles. Recondition existing lawns and meadow areas where minor regrading is required.

B. Recondition other existing lawn and meadow areas shown.

C. Provide fertilizer, seed and soil amendments, as specified for new lawn and meadow, and as required to provide satisfactorily reconditioned lawns and meadows. Provide new loam as required to fill low spots and meet new finish grades.

D. Till stripped, bare, and compacted areas thoroughly to a depth of 12-inches.

E. Remove diseased or unsatisfactory lawn and meadow areas; do not bury into soil. Remove topsoil containing extraneous materials resulting from CONTRACTOR'S operations including oil drippings, stone, gravel and other construction materials.

F. In areas approved by ENGINEER, where substantial lawns and meadows remain (but are thin), mow, dethatch, core aerate and rake. Fill low spots, remove humps, cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers, as required. Apply a seedbed mulch, if required, to maintain moist condition.

G. Water newly planted areas and keep moist until new lawns and meadows are established, as specified.

3.7 ACCEPTANCE CRITERIA FOR LAWNS AND MEADOWS

A. Lawn and meadow Work will be considered acceptable when:

1. Seeded Lawn: When a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 square feet and bare spots not exceeding 5-inches by 5-inches.
2. Seeded Meadow: When a healthy, uniform, close stand of meadow grass and forbs has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 20 square feet and bare spots not exceeding 12-inches by 12-inches.

3.8 CLEANUP AND PROTECTION

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

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout extended service period and remove when service period ends. Treat, repair or replace damaged lawns and meadows.

C. Remove erosion-control measures after lawn and meadow extended service period ends.

D. Take all precautions to ensure that hydroseed slurry is only placed on the areas designated. Completely clean any overspray, on areas not designated to receive slurry.

3.9 INSPECTION AND ACCEPTANCE

A. Where lawns and meadows do not comply with specified acceptance criteria, reestablish lawns and meadows and continue extended service period until lawns and meadows comply with criteria for acceptance.

3.10 DEMONSTRATION

A. Engage installer's Site supervisor to train and instruct OWNER'S personnel in the proper maintenance of lawns and meadows and procedures to be performed throughout the year for proper care and maintenance of lawn and meadows.
   1. Include instructions and training on reconditioning established lawns and meadow and sources of lawn and meadow materials.
   2. Schedule training with OWNER, through ENGINEER, with at least seven days' advance notice.

B. Review Operation and Maintenance information and be sure all instructions are clearly understood by OWNER'S personnel and are supplemented with additional information, clarifications and instructions, as required.

C. Provide minimum of two, nonconsecutive, full days on-Site training time during day shift normal working hours.

END OF SECTION

SECTION 33 05 05

BURIED PIPING INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of buried piping, except where buried piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all buried piping Work required, beginning at the outside face of structures or structure foundations, including piping beneath structures, and extending away from structures.
      c. Work on or affecting existing buried piping.
      d. Installation of all jointing and gasket materials, specials, couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, and other Work required for a complete, buried piping installation.
      e. Supports, restraints, and thrust blocks.
      f. Pipe encasements, with the exception of piping embedded in concrete within a structure or foundation specified under Section 40 05 05, Exposed Piping Installation.
      g. Field quality control, including testing.
      h. Cleaning and disinfecting.
      i. Incorporation of valves, meters, and special items shown or specified into piping systems in accordance with the Contract Documents and as required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before buried piping Work.
   2. Coordinate with appropriate piping Sections of Division 40, Process Integration.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 31 23 05, Excavation and Fill.
   3. Section 40 05 19, Ductile Iron Process Pipe.
   4. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME Boiler and Pressure Vessel Code.
   2. ASME B31.3, Process Piping.
   3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
   4. ASTM A377, Specification for Ductile Iron Pressure Pipe
   5. ASTM B32, Specification for Solder Metal.
   6. ASTM D2321, Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
   7. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.

8. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
9. ASTM F2164, Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure.
10. ANSI/AWWA C105, Polyethylene Encasement for Ductile-Iron Pipe Systems.
11. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
12. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
13. ANSI/AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
14. ANSI/AWWA C651, Disinfecting Water Mains.
15. AWWA M23, PVC Pipe – Design and Installation.
16. AWWA M41, Ductile-Iron Pipe and Fittings.
17. ASCE 37, Design and Construction of Sanitary and Storm Sewers.
18. NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including:
      a. York County.
      b. South Carolina Department of Transportation.
      c. South Carolina Department of Health and Environmental Control.
   2. Obtain required permits for Work in roads, rights-of-way, railroads, and other areas of the Work.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Laying schedules for piping with restrained joints.
      b. Details of piping, specials, joints, harnessing and thrust blocks, and connections to piping, structures, equipment, and appurtenances.
   2. Product Data:
      a. Manufacturer's literature and specifications, as applicable, for products specified in this Section.
   3. Testing Procedures:
      a. Submit proposed testing procedures, methods, apparatus, and sequencing. Obtain ENGINEER's approval prior to commencing testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
   2. Field Quality Control Submittals:
      a. Results of each specified field quality control test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:

a. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to buried piping Work. Submittal shall show actual location of all piping Work and appurtenances at same scale as the Drawings.
b. Show piping with elevations referenced to Project datum and dimensions from permanent structures. For each horizontal bend in piping, include dimensions to at least three permanent structures, when possible. For straight runs of piping provide offset dimensions as required to document piping location.
c. Include profile drawings with buried piping record documents when the Contract Documents include piping profile drawings.
d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
1. Deliver materials to the Site to ensure uninterrupted progress of the Work.
2. Upon delivery inspect pipe and appurtenances for cracking, gouging, chipping, denting, and other damage and immediately remove from Site and replace with acceptable material.

B. Storage:
1. Store materials to allow convenient access for inspection and identification. Store material off ground using pallets, platforms, or other supports. Protect packaged materials from corrosion and deterioration.
2. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.

C. Handling:
1. Handle pipe, fittings, specials, and accessories carefully in accordance with pipe manufacturer's recommendations. Do not drop or roll material off trucks. Do not drop, roll or skid piping.
2. Avoid unnecessary handling of pipe.
3. Keep pipe interiors free from dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Buried Piping Schedule at end of this Section. Piping materials shall conform to Specifications for each type of pipe and piping appurtenances in applicable Sections of Division 40, Process Integration.

B. General:
1. Pipe Markings:
a. Factory-mark each length of pipe and each fitting with designation conforming to those on approved laying schedules.

b. Manufacturer shall cast or paint on each length of pipe and each fitting pipe material, diameter, and pressure or thickness class.

C. Polyethylene Encasement:
1. Polyethylene may be supplied in tubes or sheets.
2. Polyethylene encasement materials shall be in accordance with ANSI/AWWA C105.

D. Cathodic Protection:
1. Bonding Cables: Bonding cable and test lead wires shall be not less than No. 6 AWG, Type CP copper cathodic protection cable, with low density, high molecular weight polyethylene insulation.
2. Test Lead Stations: Provide test lead stations where shown and indicated in the Contract Documents. Standard connection boxes for test lead stations shall be plastic terminal boxes, 18 inches long and five-inch inside diameter, with locking cast iron lid with "CP TEST" cast into cover. Inside terminal box shall be terminal block with seven terminals. Terminal box shall be manufactured by C.P. Test Services "NM-7" or equal.

2.2 BURIED PIPING IDENTIFICATION

A. Polyethylene Underground Warning Tape for Metallic Pipelines:
1. Tracer tape shall be of inert, acid- and alkali-resistant, polyethylene, four mils thick, six inches wide, suitable for direct burial. Tape shall be capable of stretching to twice its original length.
2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "REUSE WATER", or other service as appropriate, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW", with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored as follows:
a. Blue, for water pipelines.
b. Green, for sewer pipelines.
3. Manufacturer: Provide products of one of the following:
a. Brady Corporation.
b. Seton Identification Products.
c. Marking Services, Inc.
d. Or equal.

B. Detectable Underground Warning Tape for Non-Metallic Pipelines:
1. Tape shall be of inert, acid- and alkali-resistant, polyethylene, five mils thick, six inches wide, with aluminum backing, and have 15,000 psi tensile strength and 80 percent elongation capability. Tape shall be suitable for direct burial.
2. Message shall read, "CAUTION [insert customized name of pipe service, i.e., "POTABLE WATER", "SANITARY SEWER", "CHLORINE GAS", or other appropriate service, as indicated in the Buried Pipe Schedule at the end of this Section] PIPE BURIED BELOW" with bold letters approximately two inches high. Messages shall be printed at maximum intervals of two feet. Tape shall be custom colored as follows:
a. Blue, for water pipelines.
b. Green, for sewer pipelines.
c. Purple, for reuse pipelines.
3. Manufacturer: Provide products of one of the following:
a. Brady Corporation.
b. Seton Identification Products.

c. Marking Services, Inc.
d. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Install piping as shown, specified, and as recommended by pipe and fittings manufacturer.
2. In event of conflict between manufacturer's recommendations and the Contract Documents, request interpretation from ENGINEER before proceeding.
3. ENGINEER will observe excavations and bedding prior to laying pipe by CONTRACTOR. Notify ENGINEER in advance of excavating, bedding, pipe laying, and backfilling operations.
4. Minimum Cover Over Buried Water Piping and Sewer Force Mains:
   a. Provide minimum cover of 30-inches, unless pipe material is ductile iron or other approved material and insulated to prevent freezing, or otherwise shown or approved by ENGINEER.
   b. For all crossings of water courses:
      1) Provide minimum cover under channel bed of 36-inches.
      2) Provide ductile iron pipe with restrained joints.
   c. For crossing of water courses greater than 15-feet in width:
      1) Provide easily-accessible valves which allow for isolating the section for testing and repair.
      2) Provide a blow-off on the side opposite the supply side. Direct blow-off away from any streams.
5. Minimum Cover Over Buried Sewer Piping:
   a. Provide minimum cover of 36-inches and maximum cover of 16-feet over PVC pipe. Provide ductile iron pipe if less than 36-inches or greater than 16-feet of cover.
6. Earthwork is specified in Section 31 23 05.
7. Excavation in excess of that required or shown, and that is not authorized by ENGINEER shall be filled at CONTRACTOR's expense with granular material furnished, placed, and compacted in accordance with Section 31 23 05, Excavation and Fill.
8. Comply with NFPA 24 for "Outside Protection", where applicable to water piping systems used for fire protection.

B. Manufacturer's Installation Specialist:
1. Provide services of competent installation specialist of pipe manufacturer when pipe installation commences for:
   a. Thermoplastic pipe.
2. Retain installation specialist at the Site for minimum of 1 day (eight hours per day at the Site) or until competency of pipe installation crew has been satisfactorily demonstrated.

C. Separation of Sewers and Potable Water Piping:
1. Horizontal Separation:
   a. Where possible, existing and proposed potable water mains and service lines, and sanitary and storm sewers shall be separated horizontally by clear distance of at least ten feet.

b. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench and with bottom of potable water main at least 18 inches above top of sewer.
c. Exception:
1) Where it is not possible to provide minimum horizontal separation between water main and sanitary sewer main as described above, construct potable water main and sewer of ceramic epoxy-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe complying with public water supply design standards of authority having jurisdiction. Hydrostatically test water main and sewer as specified in this Section prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
2) Where it is not possible to provide minimum horizontal distance between water main and storm sewer or catch basin, provide ductile iron with joints as far as possible from the storm sewer or catch basin
d. Install sewer lines, manholes, pump stations and force mains at least 100-feet from public water supply wells and at least 20-feet from any other potable water well.
e. Install water mains no less than 25-feet from any portion of a waste-water tile-filed or spray-field.

2. Vertical Separation:
a. a. Sewer Main Crossing over Water Main:
1) Provide minimum vertical distance of 18-inches between outside of potable water main and outside of sewer when sewer crosses over potable water main.
2) Provide cement-lined ductile iron sewer and water mains for a distance of 10-feet on each side of the point of crossing, with valves as far as possible from the crossing. Provide valves on sewer and water mains that comply with drinking water standards.
3) Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
b. Sewer Main Crossing under Water Main:
1) Provide minimum vertical distance of 18-inches between outside of potable water main and outside of sewer when sewer crosses under potable water main.
2) If less than 18-inches of vertical separation is possible, provide water main ceramic epoxy-lined ductile iron sewer main for a distance of 10-feet on each side of the point of crossing, with joints as far as possible from the crossing.
c. Provide adequate structural support where potable water main crosses sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
d. PVC Water Main Crossing Other Buried Pipeline Utilities:
1) Provide minimum vertical distance of 12-inches and Type 5 bedding for water main. If this requires water main deeper than 5-feet, DIP (or brass or stainless for 2” mains) may be installed with less than 12-inches clearance provided 3-feet cover is provided for water main.

D. Plugs:
1. Temporarily plug installed pipe at end of each day of work, during lunch, or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
2. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
3. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
4. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to ENGINEER.

E. Bedding Pipe: Bed pipe as specified and in accordance with details on the Drawings.
   1. Trench excavation and backfill, and bedding materials shall conform to Section 31 23 05, as applicable.
   2. Where ENGINEER deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with Section 31 23 05, Excavation and Fill. Payment for additional excavation and providing granular material will be made under the unit price payment items in the Contract.
   3. Where pipe is installed in rock excavation, Type 5 bedding or bedding as directed by ENGINEER shall be installed.
   4. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
   5. Carefully and thoroughly compact pipe bedding with hand held pneumatic compactors.
   6. Do not lay pipe until ENGINEER approves bedding condition.
   7. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

F. Laying Pipe:
   1. Conform to manufacturer's instructions and requirements of standards and manuals listed below, as applicable:
      a. Ductile Iron Pipe: ANSI/AWWA C600, ANSI/AWWA C105, AWWA M41, ASTM A377
      b. Thermoplastic Pipe: ASTM D2321, ASTM D2774, ANSI/AWWA C605, AWWA M23, AWWA M45, AWWA, M55.
      c. Sanitary and Storm Sewers: ASCE 37.
   2. Install pipe accurately to line and grade shown and indicated in the Contract Documents, unless otherwise approved by ENGINEER. Remove and reinstall pipes that are not installed correctly.
   3. Slope piping uniformly between elevations shown.
   4. Keep groundwater level in trench at least 12-inches below bottom of trench before laying pipe. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete. Keep clean and protect interiors of pipe, fittings, valves, and appurtenances.
   5. Start laying pipe at lowest point and proceed towards higher elevations, unless otherwise approved by ENGINEER.
   6. Place bell and spigot-type pipe so that bells face the direction of laying, unless otherwise approved by ENGINEER.
   7. Excavate around joints in bedding and lay pipe so that pipe barrel bears uniformly on trench bottom.
   8. Deflections at joints shall not exceed 75 percent of amount allowed by pipe manufacturer, unless otherwise approved by ENGINEER.
   9. For copper tubing, snake piping in trench to compensate for thermal expansion and contraction.
   10. Carefully examine pipe, fittings, valves, and specials for cracks, damage, and other defects while suspended above trench before installation. Immediately remove defective materials from the Site and replace with acceptable products.
   11. Inspect interior of all pipe, fittings, valves, and specials and completely remove all dirt, gravel, sand, debris, and other foreign material from pipe interior and joint recesses before pipe and appurtenances are moved into excavation. Bell and spigot-type mating surfaces shall be thoroughly wire brushed and wiped clean and dry immediately before pipe is laid.
   12. Field cut pipe, where required, with machine specially designed for cutting the type of pipe being installed. Make cuts carefully, without damage to pipe, coating or lining, and with smooth end at right angles to axis of pipe. Cut ends on push-on joint type pipe shall be

tapered and sharp edges filed off smooth. Do not flame-cut pipe. When making connections to existing mains which require water mains to be removed from service, automatic traveling pipe cutting machines will be required on 16-inch and larger.

13. Do not place blocking under pipe, unless specifically approved by ENGINEER for special conditions.
14. Touch up protective coatings in manner satisfactory to ENGINEER prior to backfilling.
15. Notify ENGINEER in advance of backfilling operations.
16. On steep slopes, take measures acceptable to ENGINEER to prevent movement of pipe during installation.
17. Thrust Restraint: Where required, provide thrust restraint conforming to Article 3.3 of this Section.
18. Exercise care to avoid flotation when installing pipe in cast-in-place concrete, and in locations with high groundwater.

G. Polyethylene Encasement:
   1. Provide polyethylene encasement for ductile iron piping to prevent contact between pipe and surrounding bedding material and backfill.
   2. Polyethylene encasement installation shall be in accordance with ANSI/AWWA C105.

H. Jointing Pipe:
   1. Ductile Iron Mechanical Joint Pipe:
      a. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
      b. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
      c. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
      d. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
      e. Push gland toward socket and center gland around pipe with gland lip against gasket.
      f. Insert bolts and hand-tighten nuts.
      g. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (inches)	Bolt Diameter (inches)	Range of Torque (ft-lbs)
3	5/8	40 to 60
4 to 24	3/4	60 to 90
30 to 36	1	70 to 100
42 to 48	1.25	90 to 120

      h. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
      i. Restrained mechanical joints shall be in accordance with Section 40 05 19, Ductile Iron Process Pipe.
   2. Ductile Iron Push-On Joint Pipe:

a. Prior to assembling joints, thoroughly clean with wire brush the last eight inches of exterior surface of spigot and interior surface of bell, except where joints are lined or coated with a protective lining or coating.
b. Wipe clean rubber gaskets and flex gaskets until resilient. Conform to manufacturer's instructions for procedures to ensure gasket resiliency when assembling joints in cold weather.
c. Insert gasket into joint recess and smooth out entire circumference of gasket to remove bulges and to prevent interference with proper entry of spigot of entering pipe.
d. Immediately prior to joint assembly, apply thin film of pipe manufacturer's recommended lubricant to surface of gasket that will come in contact with entering spigot end of pipe, or apply a thin film of lubricant to outside of spigot of entering pipe.
e. For assembly, center spigot in pipe bell and push pipe forward until spigot just makes contact with rubber gasket. After gasket is compressed and before pipe is pushed or pulled in the rest of the way, carefully check gasket for proper position around the full circumference of joint. Final assembly shall be made by forcing spigot end of entering pipe past gasket until spigot makes contact with base of the bell. When more than a reasonable amount of force is required to assemble the joint, remove spigot end of pipe to verify proper positioning of gasket. Do not use gaskets that have been scored or otherwise damaged.
f. Maintain an adequate supply of gaskets and joint lubricant at the Site when pipe jointing operations are in progress.

3. Ductile Iron Proprietary Joints:
   a. Install pipe that utilizes proprietary joints for restraint specified in Section 40 05 19, Ductile Iron Process Pipe, or other such joints, in accordance with manufacturer's instructions.
4. Thermoplastic Pipe Joints:
   a. Bell and Spigot Joints:
      1) Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.
      2) Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.
5. Copper Tubing Joints:
   a. Soldered Joints:
      1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
      2) Ream or file pipe to remove burrs.
      3) Clean and polish contact surfaces of joints.
      4) Apply flux to both male and female ends.
      5) Insert end of tube into full depth of fitting socket.
      6) Heat joint evenly.
      7) Form continuous solder bead around entire circumference of joint starting at the bottom.
   b. Threaded Joints:
      1) When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.

2) Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same outside diameter as tube to be flared.
3) Tubing to be flared shall be soft temper or annealed prior to flaring.
4) End of tube shall be cut square and reamed to remove burrs.
5) Tube that is out-of-round shall be resized back to round.
6) Clean and polish contact surfaces of joints using an abrasive cloth.
7) Place flare nut over the end of tube with threads closest to end being flared.
8) Insert appropriate length of tube between flaring bar of flaring tool and position the yolk with flaring cone over tube end and clamp yoke in place.
9) Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.
10) Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

6. Mechanical Coupling Joints:
   a. Do not use sleeve couplings in water mains except for: connections to existing mains, connections between different pipe materials, or as necessary for repairs during pressure/leakage tests.
   b. Provide couplings for sewer lines 12-inches and smaller per Section 33 05 06, Couplings, Adapters and Specials.
   c. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.
   d. Loosen the stainless steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.

I. Backfilling:
1. Conform to applicable requirements of Section 31 23 05, Excavation and Fill.
2. Place backfill as Work progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of backfill.

J. Connections to Valves and Hydrants:
1. Install valves and hydrants as shown and indicated in the Contract Documents.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves located at pipeline terminations.

K. Transitions from One Type of Pipe to Another:
1. Provide necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

L. Closures:
1. Provide closure pieces shown or required to complete the Work.

3.2 TRACER WIRE INSTALLATION

A. Detectable Underground Tracer Wire for Non-Metallic Pipelines:
1. Provide and install a 14-gauge solid copper wire on top of all new non-metallic pipeline.
2. Secure the wire to the pipe with duct tape near every bell and at the center of each pipe joint.
3. Fasten the wire securely to a cast iron fitting at each main line valve and to service lines.

B. Detectable Underground Tracer Wire for Hydrant Leads:
   1. Provide and install a 14-gauge solid copper wire around all new hydrant leads.
   2. Install wire around all horizontal portions of the hydrant lead, as well as the buried hydrant gate valve.
   3. Wrap the wire at frequency of no less than one revolution per linear foot of pipe.
   4. Fasten the wire securely to the 90-degree fittings at each end of the horizontal portion of hydrant lead.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on pressure piping systems where shown or indicated in the Contract Documents.

B. Thrust restraint shall be accomplished by using restrained pipe joints. Concrete thrust blocks and/or harnessing buried pipe may be used if approved by the ENGINEER. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Buried Piping Schedule at the end of this Section.

C. If so approved, place concrete thrust blocks against undisturbed soil. Thrust blocks shall not be installed where undisturbed soil does not exist and/or where the Site consists of backfill material.

D. Restrained Pipe Joints:
   1. Pipe joints shall be restrained by means suitable for the type of pipe being installed.
      a. Ductile Iron, Push-on Joints and Mechanical Joints: Restrain with proprietary restrained joint system as specified in Section 40 05 19, Ductile Iron Process Pipe; lugs and tie rods; or other joint restraint systems approved by ENGINEER.
      b. Thermoplastic Joints: Where bell and spigot-type or other non-restrained joints are utilized, provide tie rods across joint or other suitable joint restraint system, subject to the approval of ENGINEER.

E. Concrete Thrust Blocks:
   1. Provide concrete thrust blocks on pressure piping at changes in alignment of 15 degrees or more, at tees, plugs and caps, and where shown or indicated in the Contract Documents. Construct thrust blocks conforming to 03 00 05, Concrete.
   2. Install thrust blocks against undisturbed soil. Place concrete so that pipe and fitting joints are accessible for repair.
   3. Concrete thrust block size shall be as shown on the Drawings or as approved by ENGINEER.

F. Harnessed lengths of buried pipe shall be as shown on the Drawings.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Underground Facilities:
   1. Locations of existing Underground Facilities shown on the Drawings should be considered approximate.
   2. Determine the true location of existing Underground Facilities to which connections are to be made, crossed, and that could be disturbed, and determine location of Underground Facilities that could be disturbed during excavation and backfilling operations, or that may be affected by the Work.

B. Taking Existing Pipelines and Underground Facilities Out of Service:
   1. Conform to Section 01 14 16, Coordination with Owner's Operations.
   2. Do not take pipelines or Underground Facilities out of service unless specifically listed in Section 01 14 16, Coordination with Owner's Operations, or approved by ENGINEER.
   3. Notify ENGINEER in writing prior to taking pipeline or Underground Facilities out of service. Shutdown notification shall be provided in advance of the shutdown in accordance with the General Conditions and Section 01 14 16, Coordination with Owner's Operations.

C. Work on Existing Pipelines or Underground Facilities:
   1. Cut or tap piping or Underground Facilities as shown or required with machines specifically designed for cutting or tapping pipelines or Underground Facilities, as applicable.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
   3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
   4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations and Section 01 73 29, Cutting and Patching.

3.5 FIELD QUALITY CONTROL

A. General:
   1. Test all piping, except as exempted in the Buried Piping Schedule in this Section.
   2. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   3. Conduct all tests in presence of ENGINEER.
   4. Remove or protect pipeline-mounted devices that could be damaged by testing.
   5. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into piping being tested. CONTRACTOR shall provide fluid for other types of testing required.
   8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
   9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of OWNER. Unless otherwise included in the Work, repair of existing piping or Underground Facilities will be paid as extra Work.

B. Test Schedule:
   1. Refer to the Buried Piping Schedule in this Section for type of test required and required test pressure.
   2. Unless otherwise specified, required test pressures are at lowest elevation of pipeline segment being tested.
   3. For piping not listed in Buried Piping Schedule in this Section:
      a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig. Provide process air pipe test for pipe that will convey air or gas under pressure or vacuum, except chlorine gas, which requires separate test.

b. Use exfiltration testing, low-pressure air testing, or vacuum testing for other piping.
c. Disinfect for bacteriological testing piping that conveys potable water.

4. Test Pressure:
   a. Use test pressures listed in Buried Piping Schedule in this Section.
   b. If test pressure is not listed in Buried Piping Schedule, or if test is required for piping not listed in the Buried Piping Schedule, test pressure will be determined by ENGINEER based on maximum anticipated sustained operating pressure and methods described in applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
1. Preparation for Testing:
   a. For thermoplastic pipe, follow procedures described in Section 7 of ANSI/AWWA Standard C605.
   b. For ductile iron pipe, follow procedures described in ANSI/AWWA Standard C600.
   c. Prior to testing, ensure that adequate thrust protection is in place and joints are properly installed.
   d. The maximum length pipe tested in one test shall be 5,000-feet.
2. Test Procedure:
   a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in pipe being tested.
   b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
   c. Examine exposed joints and valves, and make repairs to eliminate visible leakage.
   d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
   e. Timed test period shall not begin until after pipe has been filled, exposed to required wetting period, air has been expelled, and pressure stabilized.
   f. Timed Test Period: After stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure.
   g. Pump from test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at 15 minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of test pressure during timed test period. Allowable leakage rates for piping are:
   a. No Leakage: Pipe with fused, threaded, soldered, or brazed joints.
   b. Rates based on formula or table in ANSI/AWWA Manual M41:
      1) Metal pipe joined with rubber gaskets as sealing members, including the following joint types:
         a) Bell and spigot and push-on joints.
         b) Mechanical joints.
         c) Bolted sleeve type couplings.
         d) Grooved and shouldered couplings.
   c. Rates based on formula or table in ANSI/AWWA C605:
      1) Plastic pipe joined with O-ring gasket sealing members.

D. Exfiltration Testing for Manholes:
1. Test 25-percent of all manholes, as selected by ENGINEER.

2. Plug and bulkhead inlet and outlet pipes and lateral connections to manhole to be tested and admit fluid until the manhole is full.
3. Allow water level to saturate, then refill and mark the level of water.
4. Test duration shall be at least two hours.
5. Allowable leakage rate shall be 3-gallons per hour.

E. Gravity Sewer Pipe Leakage Testing
   1. After minimum 10-days following completion of backfill, determine level of the ground water table and submit to County Inspector. If level of ground water table is above the top of the pipe, test the sewer line for infiltration. Otherwise, use low pressure air test.
   2. Infiltration Test:
      a. Test up to 1-mile section of constant diameter pipe at a time.
      b. Isolate test section by installing suitable upstream watertight bulkheads.
      c. Take 6 readings at 5-minute intervals and use the average to determine rate of infiltration for the test section.
      d. Infiltration shall not exceed 100 gallons per day per inch-diameter per mile.
      e. Isolate and test any individual section between two manholes separately if so directed by ENGINEER.
      f. Facilitate York County Water/Sewer Department to use video equipment in any section to detect infiltration sources.
   3. Low Pressure Air Test:
      a. Plug and bulkhead ends and lateral connections of pipe segment to be tested.
      b. Required test pressure shall be increased by an amount equal to the elevation of groundwater above invert of lowest point of pipe segment being tested.
      c. Test in accordance with requirements of authority having jurisdiction.
      d. For thermoplastic pipe, use test procedures described in ASTM 1417.

F. Vacuum Testing:
   1. Plug and bulkhead ends and lateral connections of pipe segment or manhole to be tested.
   2. Following set-up of test apparatus, draw vacuum of ten inches of mercury on pipe segment or manhole being tested.
   3. Start test upon reaching specified test vacuum. Test duration shall be 15 minutes.
   4. Record vacuum drop at end of test. If vacuum drop is greater than one inch of mercury, pipe segment or manhole fails the test and shall be repaired and retested. If vacuum drop is less than one inch of mercury, pipe segment or manhole passes the test.

G. Vertical Deflection Test for Thermoplastic Pipe:
   1. Conduct vertical deflection test at least thirty days after backfill has been placed.
   2. Perform test using one of the following two methods
      a. Manually pull pin-type vertical gauge mounted on sled through pipe. Gauge shall be manufactured by Quality Test Products, or equal. Set gauge so that sled will stop if vertical deflection of pipe exceeds five percent. Excavate and re-install piping that fails deflection test, and retest.
      b. Use rigid ball or mandrel for deflection test, which shall have diameter of at least 95 percent of base inside diameter or average inside diameter of piping, depending on which is specified in applicable ASTM standard, including appendix, to which pipe is manufactured. Perform test without mechanical pulling devices. Re-install and retest pipe segments that exceed deflection of five percent.

H. Bacteriological Testing:

1. Bacteriological testing for potable water lines, finished water lines, and other piping in accordance with the Buried Piping Schedule, is specified in Part 3 of this Section.

3.6 CLEANING AND DISINFECTION

A. Cleaning, General: Clean pipe systems as follows:
   1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in manner approved by ENGINEER, prior to placing in service. Flush chlorine solution and sodium hypochlorite piping with water.
   2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.
   3. For piping that requires disinfection and has not been kept clean during storage or installation, swab each section individually before installation with five percent sodium hypochlorite solution.

B. Disinfection:
   1. Disinfect all potable and finished water piping.
   2. Suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures may be considered for acceptance by ENGINEER.
      a. Prior to disinfection, clean piping as specified and flush thoroughly.
      b. Conform to procedures described in ANSI/AWWA C651. Use continuous feed method of disinfecting, unless alternative method is acceptable to ENGINEER.
   3. Water for initial flushing, testing, and disinfection will be furnished by OWNER. CONTRACTOR shall provide all temporary piping, hose, valves, appurtenances, and services required. Cost of water required for redisinfection will be paid by CONTRACTOR to OWNER at water utility's standard rates.
   4. Chlorine shall be provided by CONTRACTOR.
   5. Bacteriologic tests shall be performed by CONTRACTOR. Provide certified test laboratory report to OWNER.
   6. Chlorine concentration in water entering the piping shall be between 50 and 100 ppm, such that minimum residual concentration of 25 mg/L remains after 24-hour retention period. Disinfect piping and all related components. Repeat as necessary to provide complete disinfection.
   7. After required retention period, flush chlorinated water to closed drain line, unless otherwise acceptable to ENGINEER. Properly dispose of chlorinated water in accordance with Laws and Regulations. Do not discharge chlorinated water to storm sewers, ditches, or overland.

3.7 CATHODIC PROTECTION

A. General:
   1. Provide cathodic protection for buried steel pipelines.
   2. Provide insulated joint at each of the following:
      a. Connection to steel water tanks and each branch connecting to a water line.
      b. Connection between concrete pipe and steel pipe, and between ductile iron pipe and steel pipe.
      c. Connection through wall.
      d. Where indicated.
   3. Provide electrical bond across all other gasketed steel pipe joints.
   4. Provide test lead stations for monitoring electrical currents on pipeline at locations shown and indicated in the Contract Documents.

B. Details of Cathodic Protection:
   1. Insulated Joints: Where shown or indicated in the Contract Documents, provide insulated flange type joints. After joint is made, provide exterior coating around joint as specified for piping being joined.
   2. Electrical Bond Across Rubber Gasket Joints: Provide two electrical bonding cables across each rubber-gasketed bell and spigot joint. Before exterior coating is applied to bell and spigot joints, two small areas of metal shall be exposed on each side of joint, one on spigot ring and one on bell. Thoroughly clean each area and bond two cathodic protection cables to pipe, one on each side of joint. Bond each cable by thermite process. Coat completed connections and exposed metal as specified for exterior coating of pipe being joined.
   3. Electrical Bond Across Mechanical Couplings: Provide two electrical bonding cables across each mechanical coupling. Before the exterior coating is applied to mechanical couplings, expose two small areas of metal on pipe surface on each side of coupling, on middle ring and on each follower ring of coupling. Thoroughly clean each area and bond two cathodic protection cables to pipe, one on each side of joint and to middle ring and follower rings of mechanical coupling. Bond each cable by thermite process. Coat completed connections and exposed metal as specified for exterior coating of pipe being joined.
   4. Electrical Bond Across Valves and Flanges: Provide two electrical bonding cables across valves and flanged connections other than insulated flange type joints. Provide electrical bond as specified for bond across rubber gasket joints.
   5. Test Lead Stations: Provide test lead stations where shown and indicated in the Contract Documents. Terminate test lead on ground surface in standard connection box at a protected location acceptable to ENGINEER.

3.8 SCHEDULES

A. Schedules listed below, following the “End of Section” designation, are part of this Specification section.
   1. Table 33 05 05-A, Buried Piping Schedule.

END OF SECTION

TABLE 33 05 05-A, BURIED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks

The following abbreviations are used in the Buried Piping Schedule.

A. Service Abbreviations

Service	Abbrev		Service	Abbrev.
Sanitary Sewer	SAN		Wastewater	WW
Storm Sewer	ST		Chlorine Solution	CLS
Sanitary Force Main	SFM		Sodium Hypochlorite	NAOCL
Raw Water	RW		Plant Effluent Water	PEW
Potable Water	PW		Drain	DR
County Water	CW		Chlorine Gas	CLG

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI		Polyvinyl Chloride	PVC
Cast Iron	CI		Copper	C
Chlorinated Polyvinyl Chloride	CPVC			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Asphaltic Coated	AC
Painted	P		Polyethylene Wrapped	PEW
Ceramic Epoxy	CE			

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Bell and Spigot	BS		Restrained Mech. Joint	RMJ
Restrained Bell and Spigot	RBS		Soldered	Sd
Push-on Joint	POJ		Threaded	Thd
Restrained Push-on Joint	RPOJ		Split Flexible Coupling	SPFC
Mechanical Joint	MJ		Plasticized PVC Coupling	PPVC
Sleeve-type Flexible Coupling	SLFC			

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ( )		Process Air Pipe Test (test pressure in psig)	PA ( )
Exfiltration	EX		Vacuum Test	VAC
Low-pressure Air Sewer Test	AIR		Disinfection and Bacteriological Testing	DBT
Vertical Deflection	VD		No Test Required	NR

SECTION 33 05 06

COUPLINGS, ADAPTERS AND SPECIALS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install all couplings, adapters, and specials for process piping.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before couplings, adapters, and specials for process piping Work.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation
   2. Section 40 05 05, Exposed Piping Installation.
   3. Section 40 05 19, Ductile Iron Process Pipe.
   4. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   2. ASME B31, Standards of Pressure Piping.
   3. ASTM F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
   4. AWWA C606, Grooved and Shouldered Joints.
   5. ASTM C1173, Standard Specification for Flexible Transition Couplings for Underground Piping Systems.
   6. ASTM D2000, Standard Classification System for Rubber Products in Automotive Systems.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer shall have at least five years experience producing substantial similar products to those specified and shall be able to provide documentation of at least five installations in satisfactory operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain each type of coupling, adapter, and special for process piping product included in this Section, regardless of component manufacturer, from a single couplings, adapters, and specials manufacturer.
   2. Supplier shall prepare, or review, and approve all submittals for components furnished under this Section.

3. Components shall be suitable for specified service conditions and be integrated into overall assembly by the Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Product Data:
      a. Submit product data on each type of coupling, expansion joint, and other piping specialties and accessories, including gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.
   3. Tapping Plan: Submit a complete tapping plan including, but not limited to, the following elements:
      a. Sequence and schedule of tapping operation.
      b. Means and methods of installing tap machine, sleeves and valves including area of excavation needed for tapping machine and method for supporting pipe and valve during tapping operation.
      c. Identify necessary coordination with other elements of work.
      d. Other elements of operation for safe and complete installation of tapped system.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. When requested by ENGINEER submit certificate attesting to compliance with standards referenced in this Section, signed by manufacturer.
   2. Manufacturer's Instructions:
      a. Provide instructions for handling, storing, installing, and adjusting of products.
   3. Source Quality Control:
      a. When requested by ENGINEER, submit results of source quality control tests.
   4. Qualifications Statements:
      a. Submit qualifications of manufacturer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation.

PART 2 PRODUCTS

2.1 COUPLINGS

A. Sleeve-type (Transition), Flexible Couplings, for water pipe 16-inches diameter and smaller:
   1. Pressure and Service: Same as connected piping.
   2. Products and Manufacturers: Provide products of one of the following:
      a. Style 253, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
      b. Style 441, by Smith Blair, Inc.
      c. Or equal.
   3. Material: Ductile Iron.
   4. Gaskets: O-ring type gaskets at each end of the sleeve.

5. Bolts and Nuts: Alloy steel, corrosion resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
6. Harnessing:
    a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
    b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
    c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
    d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
7. Remove pipe stop(s) if used, unless otherwise shown or specified.

B. Sleeve-type (Transition), Flexible Couplings, for water pipe greater than 16-inches diameter:
1. Pressure and Service: Same as connected piping.
2. Products and Manufacturers: Provide products of one of the following:
    a. Style 253, as manufactured by Dresser Piping Specialties, part of Dresser, Inc.
    b. Style 441, by Smith Blair, Inc.
    c. Or equal.
3. Material: Steel.
4. Gaskets: O-ring type gaskets at each end of the sleeve.
5. Bolts and Nuts: Alloy steel, corrosion resistant, primer-coated. For buried or submerged applications, provide stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and with nitrided stainless nuts.
6. Harnessing:
    a. Harness couplings to restrain pressure piping. For pipelines that will be under pressure, test pressures are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
    b. Tie adjacent flanges with bolts of corrosion-resistant alloy steel. Provide flange-mounted stretcher bolt plates to be designed by manufacturer, unless otherwise approved. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers.
    c. On plain-end piping, for harnessing couplings, provide anchor restraint system such as Dresser Piping Specialties STAR Anchor Style 443, or equal.
    d. Conform to dimensions, size, spacing, and materials for lugs, bolts, washers, and nuts as recommended by manufacturer and approved by ENGINEER for pipe size, wall thickness, and test pressure required. Provide minimum 5/8-inch diameter bolts.
7. Remove pipe stop(s) if used, unless otherwise shown or specified.

C. Transition Couplings for gravity sewer pipe:

1. Provide mechanical couplings for gravity sewer pipe in accordance with ASTM C1173 and CSA B602.
2. Pressure and Service: Same as connected piping.
3. Products and Manufacturers: Provide products of one of the following:
   a. Fernco, Strong Back.
   b. Mission.
   c. Romac.
   d. Gladding-Mcbean Repair
   e. Or equal.
4. Material: Stainless steel shield and a molded in busing.
5. Gaskets: Manufactured to meet the requirements of ASTM D 5926 or compounded for water and sewer service in accordance with ASTM D2000 MAA 610.
6. Clamps: Manufactured to meet the requirements of CSA B602. Clamp Housing and Clamp Band 301 Stainless Steel. Clamp Screw 305 Stainless Steel.

2.2 MISCELLANEOUS SPECIALTIES AND ACCESSORIES

A. Dielectric Connections:
   1. General: Where copper pipe connects to steel pipe, cast-iron pipe, or ductile iron pipe, provide either dielectric union or an insulating section of rubber or plastic pipe. When used, insulating section shall have minimum length of 12 pipe diameters.
   2. Manufacturers: Provide products of one of the following:
      a. Epco Sales, Inc.
      b. Watts Regulator Company.
      c. Capitol Manufacturing Company.
      d. Wilkins, a Zurn Company.
      e. Or equal.
   3. Ratings:
      a. Dielectric Unions: Rated for 250 psi, ANSI B16.39.
      b. Flanges: 175 psi, ANSI 16.42 (Iron), ANSI 16.24 (Bronze)
   4. Insulating Sections: Rated for same pressure as associated piping test pressure. Material shall be suitable for the application and service.
   5. Bodies and flanges, and bolts and nuts shall be steel with galvanized coating. Provide nylon insulator, brass tailpiece and EPDM gaskets.

2.3 METER SETTERS

A. General: Provide horizontal inlet and outlet meter setter, lock wing ground key angle meter valve with meter flange on inlet and angle dual check valve with meter flange on outlet. Provide bypass with lock wing ball valve and check valve.

B. Products and Manufacturers: Provide the following:
   1. Mueller Company LLC, Model H-1423-2N.
   2. Or equal.

C. Dimensions: 1-1/2” shall be 12” high by 12-1/4” length and 2” shall be 12” high by 17-1/4” length.

2.4 SERVICE SADDLES

A. Brass Service Saddles on PVC Mains:

1. General: Provide service saddle as single strap design manufactured in bronze with corporation thread outlet.
2. Manufacturers: Provide products of one of the following:
   a. Ford S-70.
   b. McDonald 3801 or 3805.
   c. Mueller H-13000 series.
   d. Romac 101B.
   e. Power Seal 3401.
   f. Or equal.

B. Ductile Iron Service Saddles:
1. General: Provide service saddle manufactured in ductile iron with corporation thread outlet.
2. Manufacturers: Provide products of one of the following:
   a. Double Strap:
      1) Ford F202.
      2) Smith-Blair 313.
      3) JCM Industries 402.
      4) Romac 202U.
      5) PowerSeal 3413DI.
      6) Or equal.
   b. Stainless Steel Strap:
      1) Ford FCD202.
      2) Smith-Blair 317.
      3) JCM Industries 405.
      4) Romac 202S.
      5) PowerSeal 3417DI.
      6) Or equal.

C. Stainless Steel Service Saddles:
1. General: Provide service saddle manufactured in stainless steel with corporation thread outlet.
2. Manufacturers: Provide products of one of the following:
   a. Ford FS323.
   b. Romac 304.
   c. Or equal.

2.5 METER BOXES

A. General: Provide meter boxes for all meters as required.

B. Manufacturers: Provide products of one of the following:
1. Size of meter ¾", residential, provide box manufactured of polyethylene plastic using the structural foam method of construction. The cover shall be manufactured of cast iron (LYLV244-233-LL-G as manufactured by Ford Meter Box Company, or equal).
2. Size of meter ¾", irrigation, provide box manufactured of polyethylene plastic using the structural foam method of construction. The cover shall be two piece, lock down, manufactured of cast iron (DG218-243 as manufactured by Ford Meter Box Company, or equal).

3. Size of meter 1”, provide box manufactured of cast iron. The cover shall be lock down, manufactured of cast iron (LYLBB144-444-G-NL as manufactured by Ford Meter Box Company, or equal).
4. Size of meter 1-1/2” and 2”, provide box manufactured of polymer concrete meeting ANSI/SCTE-77 Tier 22 (Model 1730 as manufactured by Oldcastle Infrastructure, or equal).

2.6 PAINTING

A. Shop Painting:
   1. Clean and coat ferrous metal surfaces of products in the manufacturer’s shop in accordance with the following
      a. For Submerged items: Prime Coat, first coat, and second coat of paint shall be Dura-Plate 235 Multipurpose Epoxy B67-235 B67V235 Hardener
         1) Dry Mills: 4-6 mils for each coat
      b. For Non-Submerged Items: Prime Coat and first coat of paint shall be Dura-Plate 235 Multipurpose Epoxy B67-235 B67V235 Hardener. The Second coat shall be Hi-Solids Polyurethane B65-300 Series Color, B60V30 Hardener or Acrolon 218 HS Acrylic Polyurethane B65-600 Series B65V600 Hardener.
         1) Prime Coat, Dry Mills: 4-6 Mils.
         2) First Coat, Dry Mills: 4-6 Mils.
         3) Second Coat, Dry Mills: 3-4 Mils.
   2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound that shall be maintained during storage and until products are placed into operation.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect materials for defects in material and workmanship. Verify compatibility of products with pipe, fittings, valves, and appurtenances.

3.2 INSTALLATION

A. Installation:
   1. Install piping specialties in accordance with the Contract Documents and manufacturer’s instructions.
   2. For buried installations, refer to Section 33 05 05, Buried Piping Installation.
   3. For exposed installations, refer to Section 40 05 05, Exposed Piping Installation.

B. Adjust joints as required to ensure that expansion joints will be fully extended when ambient temperature is at minimum operating temperature, and fully compressed at maximum operating temperature for the system in which expansion joints are installed.

END OF SECTION

SECTION 33 05 13

MANHOLES AND STRUCTURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all precast and cast-in-place manholes.

B. General:
   1. Manholes and structures shall conform in shape, size, dimensions, material, and other respects to the details shown or as directed by ENGINEER.
   2. Cast-iron frames, grates and covers shall be the standard frame and grate or cover unless otherwise shown and shall be as specified in Section 05 56 00, Metal Castings.
   3. Concrete for cast-in-place manholes and structures and for inverts in precast and masonry manholes and structures shall be Class “A” and shall conform to the requirements specified under Section 03 00 05, Concrete.
   4. All manholes and structures shall be precast construction, unless otherwise shown. All sanitary or process manholes and structures carrying untreated wastewater shall be PVC lined or coated with Saueriesen or Sewer Shield 100 or Tnemec Perma-Shield 431.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 56 00, Metal Castings.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
      b. ASTM C32, Specification for Sewer and Manhole Brick (made from Clay or Shale).
      c. ASTM C398, Standard Practice for Use of Hydraulic Cement Mortars in Chemical-Resistant Masonry.
      d. ASTM C443, Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
      e. ASTM C478, Specification for Precast Reinforced Concrete Manhole Sections.
      f. ASTM C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
   2. American Water Works Association, (AWWA).
      a. AWWA C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
      b. AWWA C302, Reinforced Concrete Pressure Pipe, Non-cylinder Type, for Water and Other Liquids.
   3. National Precast Concrete Association
      a. Manhole Invert Channels; Tech Notes.

1.3 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit drawings showing design and construction details of all precast concrete and cast-in-place manholes and structures, including details of joints between the manhole bases and riser sections and stubs or openings for the connections.
      b. Submit drawings for slab and wall reinforcing for 6-foot diameter and larger manholes for approval.
      c. Submit drawings of strap on vents, mountings straps and anchor
   2. Submit manufacturer's certification for 1,000-pound pull-out test for each manhole step with each shipment. Certification shall include manhole location, date of test and results.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLES AND STRUCTURES

A. Precast manholes and structures shall conform to the details shown. Provide cast-in-place concrete bases if shown on the drawings.

B. Except where otherwise specified precast manhole components shall consist of reinforced concrete pipe sections especially designed for manhole construction and manufactured in accordance with ASTM C 478, except as modified herein.

C. Precast, reinforced concrete manhole bases, riser sections, flat slabs and other components shall be manufactured by wet cast methods only, using forms which will provide smooth surfaces free from irregularities, honeycombing or other imperfections.

D. Joints between manhole components shall be the tongue and groove type and shall conform to ASTM C443. Joints shall be sealed by employing a single, continuous rubber O-ring gasket and shall conform to ASTM C443 or with butyl rubber sealants conforming with ASTM C990. Butyl rubber sealant shall be "Rubber Seal" as manufactured by Ru Van, Inc., or approved equal. The circumferential and longitudinal steel reinforcement shall extend into the bell and spigot ends of the joint without breaking the continuity of the steel. Joints between the base sections, riser sections and top slabs of manholes 72-inches in diameter and less shall be rubber and concrete joints. Joints for manhole components greater than 72-inches in diameter shall be provided with steel bell and spigot rings.

E. All precast manhole components shall be of approved design and of sufficient strength to withstand the loads imposed upon them. They shall be designed for a minimum earth cover loading of 130 pounds per cubic foot, an HL-93 wheel loading, and an allowance of 30 percent in roadways and 15 percent in rights-of-way for impact. Manhole bases shall have two cages of reinforcing steel in their walls, each of the area equal to that required in the riser sections. Wall thickness shall be a minimum of $1/12^{th}$ of the inside diameter of the manhole and not be less than 5-inches. Concrete top slabs shall not be less than 8-inches thick.

F. Lifting holes, if used in manhole components, shall be tapered, and no more than two shall be cast in each section. Expansion grout shall be furnished to seal the lifting holes. The lifting holes shall be made to be sealed by expansion grout from the outside face of the section only.

G. The point of intersection (P.I.) of the sewer pipe centerlines shall be marked with 1/4-inch diameter steel pin firmly enclosed in the floor of each manhole base and protruding approximately 1-inch above the finished floor of the base.

H. Mark date of manufacture and name or trademark of manufacturer on inside of each section.

I. The barrel of the manhole shall be constructed of various lengths of riser pipe manufactured in increments of one foot to provide the correct height with the fewest joints. Openings in the barrel of the manholes for sewers or drop connections will not be permitted closer than one foot from the nearest joint. Special manhole base or riser sections shall be furnished as necessary to meet this requirement.

J. A precast slab or eccentric or concentric cone, as shown or approved, shall be provided at the top of the manhole barrel to receive the cast iron frame and cover.

K. Eccentric cones with bolt down frame and cover shall have a minimum vertical height, as measured from the top of the cone to the bottom of the bell, of 32-inches. Eccentric cones without bolt down frame and cover to be installed flush to finish grade shall have a minimum vertical height of 24-inches.

L. Concentric cones with a vertical height of 20-inches may be used on 4-foot diameter manholes less than 5-feet deep.

M. Transition cone sections for an eccentric transition from a 60-inch riser to a 48-inch cone section shall be placed directly beneath the 48-inch cone.

N. Transition slabs for 6-foot diameter and larger manholes to be buried shall be placed a minimum of 5-feet above the invert shelf. Flat top slabs for 6-foot and larger diameter manholes shall not be used if manhole is located within pavement or maintained lawns.

O. Connectors between manholes and pipe shall be standard mechanical boot type connectors, conforming to ASTM C923, which allow for the expansion ring at the manhole wall to be completely seated in a vertical plane. Compression type connectors shall not be used.
   1. Approved Manufacturers of mechanical boot type connectors include:
      a. Quik-LOK by A-LOK Products, Inc.
      b. G-3 by A-LOK Products, Inc.
      c. Or Approved Equal.

P. Grading Rings: Modular precast concrete and lined with same materials as manhole.

Q. Flexible Joints: Comply with ASTM C923.

2.2 MASONRY COMPONENTS

A. Masonry Work, where shown or otherwise approved by ENGINEER, shall conform to the following:
   1. Brick shall conform to the requirements of: ASTM C32, Grade MS for manhole brick.
   2. Mortar shall be portland cement 1:3 mix and in accordance with ASTM C398.
   3. Cement shall be Type II portland cement as specified for concrete masonry.

2.3 MISCELLANEOUS METALS

A. Metal frames and covers and similar required items shall be provided as shown and in accordance with Section 05 56 00, Metal Castings.

2.4 DROP CONNECTIONS

A. Drop connections for manholes and structures shall be constructed where shown or directed by the ENGINEER and shall conform to the design and details shown. Concrete for pipe encasement shall be Class “B” as specified under Section 03 00 05, Concrete. Concrete shall be bonded to manhole in the manner shown or otherwise approved by ENGINEER.

B. Pipe for inside drop connections shall be SDR 35 PVC.

C. Drop connections shall not enter the manhole in the cone section.

D. Outside drops shall only be installed to address elevation differences of minimum 2-feet. The influent pipe of an outside drop shall be a minimum pipe length of 18-feet.

E. Inside drop connections shall only be installed when safety considerations or work space limitations preclude installing an outside drop connection, and with Engineer approval. Inside drops shall not be installed on 4-foot diameter manholes.

2.5 MANHOLE STEPS

A. Provide access steps on all manholes with eccentric cones.

B. Steps shall be copolymer polypropylene and conform to ASTM C478 and current OSHA regulations.

C. Steps and common straight wall of manholes with eccentric cones and flat slab tops shall be located over widest shoulder of manhole invert.

2.6 MANHOLE VENT PIPES

A. Furnish 5-inch welded steel vent pipes as shown on the drawings. Unless otherwise specified, vent pipe shall be Schedule 40, grade “B” steel in conformance with ASTM A139, with minimum yield strength of 35,000 pounds per square inch.

B. Vent pipes shall have inside coal tar lining of minimum 0.094-inch thickness in conformance with AWWA C203. Alternatively, a coal tar epoxy lining of minimum 0.024-inch dry film thickness may be used. Coal tar epoxy lining shall be: Kloppers No. 300M, Americoat No. 78, Carboline-Carbomastic No. 14, or Equal.

C. The outside surface of vent pipes shall be sand or grit blasted to commercial standard and have 1 coat of zinc chromate primer applied in conformance with Federal Specification TT-86A. Vent pipes shall be finished with 2 evenly applied coats of rust-inhibiting enamel paint. Paint to be: Kloppers Glamortex No. 501 olive green enamel, Southern Coatings Rustolay No. 5037 garden green enamel, or Equal.

D. Vent pipes shall be flanged by plain end and cast in place with bolt holes in flange straddling the vent center lines.

E. 5-inch diameter steel vent pipe shall be furnished with compatible, coated flange and all necessary hardware for bolted attachment.

PART 3 EXECUTION

3.1 MANHOLE BASES

A. Cast-in-place bases shall be placed on suitable foundations after the pipes are laid. They shall be cast monolithically to an elevation at least 12-inches above the top of the highest pipe entering the manhole, except where a drop connection is to be installed. Base, walls and bottom shall be at least of the thickness shown and reinforced to withstand the loads to be expected. Connections for sewer pipes shall conform to the details shown.

B. Precast bases shall be set on a crushed stone or crushed gravel or concrete foundation as shown. Precast bases shall be set at the proper grade and carefully leveled and aligned.

3.2 PRECAST MANHOLE SECTIONS

A. Set sections vertical with steps and sections in true alignment. The base of the bell or groove end at joints between components shall be buttered with 1:2 cement-sand mortar to provide a uniform bearing between components. All joints shall be sealed with cement mortar inside and out and troweled smooth to the contour of the wall surface. Raised or rough joint finishes will not be accepted.

B. Install sections, joints and gaskets in accordance with manufacturers recommendations.

C. Lifting holes shall be plugged with expansion grout from the outside of the barrel prior to backfilling.

3.3 MANHOLE CHANNELS

A. All invert channels through manholes and structures shall be constructed of Class “A” concrete. Channels shall be properly formed to the sizes, cross sections, grades and shapes shown or as ordered. Benches shall be built up to the heights shown or as directed by the ENGINEER and given a uniform wood float finish. Care shall be taken to slope all benches for proper drainage to the invert channel.

3.4 GRADING RINGS

A. Grading rings shall be used for all precast manholes, where required. Stacks or grade rings shall be a maximum of 21-inches in height, constructed on the roof slab or cone section on which the manhole frame and cover shall be placed. The height of the stack or grade rings shall be such as required to bring the manhole frame to the proper grade. Brick shall not be used to adjust rim elevations of above-grade manholes.

B. Each grade ring shall be laid in a full bed of mortar and shall be thoroughly bonded.

C. The outside grading rings shall be neatly plastered with 1/2-inch of cement mortar as the Work progresses.

3.5 MANHOLE FRAMES AND COVERS

A. Frames and covers shall be anchored to manhole with Red Jacket masonry anchors (or Equal) and thoroughly sealed to concrete with tar sealant putty.

B. Anchor sleeve threaded stud and nut shall be stainless or galvanized steel.

C. Provide bolt down covers as indicated on the Drawings.

3.6 STUBS FOR FUTURE CONNECTIONS

A. As shown or required for connections, cast iron sleeves, bell end tile, ductile iron or reinforced concrete pipe stubs with approved watertight plugs shall be installed in manholes and structures. Where pipe stubs, sleeves or couplings for future connections are shown or directed by the ENGINEER, CONTRACTOR shall provide all materials and labor in order to complete the Work.

3.7 FALSE WALLS

A. False walls shall be constructed in manholes when shown on the Drawings. Holes of the appropriate size shall be cored or blocked out in the manhole wall at the elevation and alignment shown on the Plans. A four-inch thick masonry wall shall be constructed in the opening. Inverts shall be constructed to match proposed pipe elevations and alignments and permit installation of the future extension without demolition work other than removal of the false wall

3.8 GRADING AT MANHOLES AND STRUCTURES

A. All manholes and structures in unpaved areas shall be built, as shown or directed by the ENGINEER, to an elevation higher than the original ground. The ground surface shall be graded to drain away from the manhole. Fill shall be placed around manholes to the level of the upper rim of the manhole frame, and the surface evenly graded on a 1 to 5 slope to the existing surrounding ground, unless otherwise shown or directed by the ENGINEER. The slope shall be covered with 4-inches of topsoil, seeded and maintained until a satisfactory growth of grass is obtained.

B. Manholes and structures in paved areas shall be constructed to meet the final surface grade. In paved areas on State Highways, all manholes and structures shall be 1/2-inch below final wearing surfaces. Manholes and structures shall not project above finished roadway pavements.

C. CONTRACTOR shall be solely responsible for the proper height of all manholes and structures necessary to reach the final grade at all locations. CONTRACTOR is cautioned that ENGINEER'S review of Shop Drawings for manhole components will be general in nature and CONTRACTOR shall provide an adequate supply of random length precast manhole riser sections to adjust any manhole to meet field conditions for final grading.

3.9 MANHOLE WATERTIGHTNESS

A. All manholes and structures shall be free of visible leakage. Each manhole shall be tested for leaks and inspected, and all leaks shall be repaired in a manner subject to ENGINEER'S

approval. Manhole testing shall conform to the requirements of Section 33 05 05, Buried Piping Installation.

3.10 FLEXIBLE PIPE JOINT AT MANHOLE BASE

A. Provide a flexible joint between each pipe entering and exiting the manhole. This may be accomplished by the installation in the manhole base of the bell end of a pipe or by other means subject to approval of ENGINEER. Joints shall be similar to the approved pipe joints. The joint into the manhole base shall be completely watertight.

3.11 PIPE JOINT AT MANHOLE BASE

A. Pipe openings shall be maximum 3-inches larger than outer diameter of pipe.

B. Openings shall be reinforced with minimum 2-square inches of steel bent to a 90-degree angle.

C. Pipe shall be centered about opening and supported by a concrete collar 12-inches greater than the outer diameter of the pipe. Collar shall extend 12-inches from the outside of the manhole wall. Collar shall be reinforced from the outside to become an integral part of the manhole invert or to a point flush with the inside wall of the manhole.

END OF SECTION

SECTION 33 05 23.17

UTILITY BORING AND JACKING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
1. Design, furnish and install the proposed piping alignment by jacking and boring construction methods, as shown on the Drawings and conform to this specification. The work includes, but not limited to, survey, design, excavation, dewatering, removal of all materials encountered in the jacking and boring operations, disposal of all material not required in the work, grouting bulkheads, testing, cleaning, restoration, and incidentals as shown on the Drawings and as specified herein.
2. Install all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the jack and bore, or tunneling installations.
3. The jacking and boring construction method shall consist of pushing (jacking) the casing pipe into the earth with a boring auger rotating with the casing/pipe to remove the spoil. The operations are to be completed while simultaneously providing ground stabilization techniques. Include provisions for preventing uncontrolled inflow of loose or saturated soils.
4. Provide additional geotechnical/subsurface investigations required to establish the appropriate parameters (i.e., limiting pressures, setback distances, depth of cover, etc.) for completing the design of the jacking and alignment, as specified herein.
5. OWNER is responsible for obtaining the required general construction permits, easements, and approvals from the South Carolina Department of Transportation (SCDOT), York County, and any respective property owners within the alignment. When encasement pipe is installed in the state rights-of-way, the entire installation shall be as required by SCDOT.

B. Coordination:
1. Review installation procedures under other Sections and other contracts and coordinate with the Work that is related to this Section.
2. Coordinate construction activities with the respective authorities.

C. Related Sections:
1. Section 31 23 05, Excavation and Fill.
2. Section 33 05 05, Buried Piping Installation.
3. Section 40 05 19, Ductile Iron Process Pipe.
4. Section 40 05 31, Thermoplastic Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are:
1. ASTM A139, Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
2. ASTM D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
3. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast.
4. ANSI/AWWA C600, Installation of Ductile-Iron Mains and Their Appurtenances.

1.3 QUALITY ASSURANCE

A. Demonstrate expertise in “trenchless” methods by providing a list of five (5) utility references for which similar work has been performed in the last two years. The references should include a name and telephone number where contact can be made to verify the CONTRACTOR’s capability. Provide documentation showing successful completion of the projects used for reference. Conventional trenching experience will NOT be considered applicable.

B. All supervisory personnel must be adequately trained and have at least ten years of experience in jack and boring operations. Submit the names and resumes of all supervisory field personnel prior to the start of construction.

C. ENGINEER will base the review of submitted details and data on the requirements of the completed work, safety of the work in regard to the public, potential for damage to public or private utilities and other existing structures and facilities, and the potential for unnecessary delay in the execution of the work. Such review shall not be construed to relieve the CONTRACTOR in any way of the CONTRACTOR’s responsibilities under the contract.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Jacking and Boring Plan describing the equipment, methods, operational procedures, construction sequence, contingency plans, and other items of concern to be performed during the jacking and boring construction.
   2. Project Safety Plan, including, but not limited to, monitoring for gases encountered, hazardous chemical list, and all MSDS and technical data sheets.
   3. Submit site layout, equipment arrangement, and entry/exit pits drawings and technical specifications of the machine and equipment (including any modifications) proposed.
   4. Submit Construction drawings, Specifications, and Contingency plans on the following items:
      a. Complete details of the site clearing, excavation, drainage, security, and equipment mobilization including, but not limited to, the methods, procedures and equipment arrangement to be used during the construction.
      b. Complete details and drawings, and calculations of the significant factors and constraints associated with jacking and boring installations including, but not limited to, fluid pressures, jacking forces, pipe capacities, jacking and receiving pits shoring design, etc.
      c. Provide plan and profile of the proposed jacking and boring alignments, indicating depth, angle of deflection, and radius of all pipe bends along the alignment.
      d. Complete details of the grouting techniques/methods to be utilized for filling grout into the annulus between the adjacent soils and the outside of the casing piping, including but not limited to, fitting procedures, equipment, pumping procedures, fluid pressures, mixtures and plug systems. Also include methods of monitoring and controlling the grouting pressures.
      e. Method of monitoring and controlling the specified line and grade of excavation including, but not limited to, the methods, procedures, reliability, and necessary ancillary equipment to be used during construction operations.
      f. Complete details of the groundwater control, launching seals, muck/spoils containment, dewatering, drying, and removal including, but not limited to, the methods, procedures, equipment, contingency plans and off-site disposal location.

g. Complete details of the casing and carrier piping capacities, maximum jacking loads, storage, assembly, and installation including, but not limited to, the methods, procedures, and equipment to be used.
h. The type of spoils separation system to be used.
i. Information regarding the inject lubricant to be used for the jacking portion of the Work.

B. Informational Submittals: Submit the following:
1. Certificates:
a. Certificate signed by manufacturer of each product certifying that product conforms to applicable referenced standards.
2. Field Quality Control Methods: At least 10 days prior to the start of the jacking and boring, submit a description of quality control methods proposed to use during the operations to the ENGINEER. Describe:
a. Procedures for controlling and checking line and grade.
b. Field forms for establishing and checking line and grade.
3. Bring to the attention of the ENGINEER any known discrepancies with actual jacking and boring methods that will be performed. This shall be stated, in writing, to ENGINEER no later than the pre-construction meeting.

C. Closeout Submittals:
1. Maintain accurate and up-to-date record documents showing modifications made in the field, in accordance with approved submittals, and other Contract modifications relative to boring and jacking Work. Submittal shall show actual location of all boring and jacking Work and appurtenances at same scale as the Drawings.
2. Show piping with elevations referenced to Project datum and dimensions from permanent structures.
3. Include profile drawings with boring and jacking record documents when the Contract Documents include boring and jacking profile drawings.
4. Submit record drawings prior to the time of Substantial Completion.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Do not place/store materials, equipment, or personnel on or around state roads.

B. Deliver materials to the site to ensure uninterrupted progress of the Work.

C. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Handling devices shall include ropes, fabric, or rubber-protected slings and straps. Chains, cables, or hooks inserted into the pipe ends shall NOT be used. Two slings spread apart shall be used for lifting each length of pipe. Do not drop or roll material off trucks.

D. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Space pipe supports suitably and of such widths as not to allow deformation of the pipe at the point of contact with the supports.

E. Limit stacking of pipe to a height that will not cause deformation of the bottom pipes under anticipated temperature conditions.

F. Securely cap/plug all ends of stored piping to prevent entry of soil, debris, and vermin.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Jack and Boring System, General:
   1. The jack and boring system shall consist of, but not limited to, the following components:
      a. Jacking system suitable for forcing the casing through the embankment.
      b. Auger Boring and Spoil removal system.
      c. Pipe lubrication system.
   2. The excavation equipment and system shall be fully capable of excavating and removing all material that will be encountered during the construction operations.
   3. The automated spoil transportation system shall match the excavation rate to the rate of spoil removal, maintaining settlement or heave within tolerances specified herein.
      a. If a slurry spoil transportation system is used, the groundwater pressure may be managed by use of the slurry pumps (which may be variable speed), pressure control valves and a flow meter. A slurry bypass unit shall be included in the system to allow the direction of flow to be changed and isolated, as needed. A solids separation process shall be provided when using slurry transportation systems. The process shall be designed to provide adequate separation of the spoil from the slurry so that the clean slurry can be returned to the cutting head for reuse.
      b. If an Auger spoil transportation system is utilized, the groundwater pressures may be managed by controlling the volume of spoil removal with respect to the advance rate (Earth Pressure Balance Method) and the application of compressed air. In soils with excessive groundwater, approval of the ENGINEER shall be required for the earth pressure balance auger systems. Approval shall be based on the evaluation of the equipment's ability to balance soil and groundwater pressures at the face, stability of the soils and the significance of the groundwater present.

B. Pipe Jacking Equipment:
   1. The main jacks shall be mounted in a jacking frame and located in the drive (starting) shaft. The jacking frame successively pushes the steel casing pipes toward a receiving shaft. The jacking capacity shall be sufficient to push the auger/boring machine and/or length of casing piping through the ground.
   2. The main jacking equipment installed shall have a capacity greater than the anticipated jacking load. The hydraulic cylinder extension rate shall be synchronized with the excavation rate of the boring, which shall be determined by the specific soils conditions.
   3. The CONTRACTOR shall provide intermediate jacking stations when the total anticipated jacking force needed to complete the installation exceeds the designed maximum jacking force of the pipe.

C. Pipe Lubrication System:
   1. Utilize a pipe lubrication system when anticipated jacking forces on the pipe are expected to exceed the capacity of the main jacks or exceed the pipe design strength with the appropriate safety factor. A prior approved lubricant shall be injected at the rear of the auger, or boring machine and, if necessary, through the casing pipe walls to lower the friction developed on the surface of the pipe during jacking.

2.2 MATERIALS

A. Carrier Piping:
   1. Carrier piping used for the conveyance of water and wastewater shall refer to Sections 33 05 05, Buried Piping Installation, and 40 05 19, Ductile Iron Pipe, or 40 05 31, Thermoplastic Pipe, for material and installation specifications.
   2. All ductile iron carrier pipe installed with joint inside an encasement pipe must utilize rigid restrained joints.
      a. Approved Manufacturers:
         1) US Pipe Mech-Lok.
         2) US Pipe MJ Harness-Lok.
         3) Approved equal.
   3. All PVC carrier pipes shall have restrained joints with a working pressure at least equal to that of the PVC pipe on which it is to be installed and a minimum safety factor of 2:1.
      a. Approved Manufactures:
         1) EBAA Iron, Inc. Series 2000PV ductile iron MEGALUG retainers with Mega-Bond Coating System.
         2) Approved equal.

B. Steel Casing Piping:
   1. Casing pipe and joints shall be constructed so as to prevent leakage of any substance from the casing throughout its length.
   2. Use only new, welded or seamless steel pipe per ASTM A-139, Grade B. Casing minimum thickness to be as shown on the Drawings. The casing wall thickness shall be designed to accommodate the maximum jacking load allowed, as well as the expected earth and live loads.
   3. Joints in steel casing pipe shall be butt-welded joints, conforming to the requirements of AWWA C206. Pipe 36 inches in diameter and larger shall be welded both inside and outside of the pipe/casing.
   4. After welding, the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating.
   5. All steel casing pipe and welds shall meet or exceed either the site-specific regulatory agency's requirement, or the manufacturer's minimum wall thickness to meet or exceed the greater of either: installation (jacking), loading, or carrier load requirements.
   6. The size (diameter) of the steel casing shall be as shown on the Drawings.
   7. All steel pipes shall be designed for the external and internal loads to which they will be subjected. Steel casing shall meet ASTM specifications and be designed to meet or exceed a minimum live load of a Cooper E-80 loading. The loading consists of 80 kip (356 kN) axle loads spaced 5-feet (1.5 m) on centers.

C. Annular Spacers
   1. Support carrier pipe within the steel casing by means of annular spacers. Casing spacers shall prevent the carrier pipe from floating, and shall electrically insulate the carrier pipe from the casing.
   2. The annular spacers shall be made of non-corrodible materials such as HDPE or stainless steel.
   3. For steel spacers, runners shall be made of polyethylene to provide dielectric insulation between the spacer and the carrier pipe.
   4. Spacers shall be installed at minimum one behind the bell end and one in the center of each 18-ft or 20-ft joint of carrier pipe in accordance with the manufacturer's recommendations.
   5. Verify size, position, spacing, and configuration of spacers with manufacturer. Final spacer installation shall be based on approved submittal.

6. Verify the tolerances of the casing spacer are compatible with the carrier pipe's outside diameter including provisions for the pipe to be slightly out-of-round.
7. Wooden skids are not acceptable.

D. Grout (Annular Backfill, between casing and adjacent soils):
1. Grout shall consist of one (1) part Portland cement, three (3) parts sand and the minimum amount of water necessary to obtain the desired consistency; and all grout mixtures shall contain 2% of bentonite by weight of the cement.
2. If voids are encountered or occur outside the encasement pipe, grout connections shall be provided and regularly spaced at 10-feet on center in the top section of the encasement pipe.

E. Casing End Seals
1. Seals shall be standard wrap-around end seals, manufactured of synthetic rubber, with self-curing rubber sealing strips.
2. The end seals shall be provided with 316- stainless steel bands and clamps.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Provide notice of intent to begin Bore and Jack operations to ENGINEER prior to beginning any Work in roadway or railway rights-of-way. Acknowledgement of intent must be received no less than 5 working days before Work begins.
2. Comply with the lawful requirements of SCDOT, York County, public agencies, and owners of public utilities or other facilities respecting the safeguarding of structures and improvements that might be endangered by the jacking and boring, or microtunneling construction operations.
3. Install the required steel casing by means of jacking and boring as shown, specified herein, and as recommended by the pipe manufacturer.
4. The jacking and boring operation, along with the installation of the casing pipe, shall be done simultaneously and continuously until the casing pipe is in final position.
5. CONTRACTOR shall be responsible for the CONTRACTOR's means and methods of jacking and boring, and shall ensure the safety of the work, the CONTRACTOR'S employees, the public, and adjacent property, whether public or private.
6. Maintain traffic flow at all times during the progress of the work. CONTRACTOR shall provide adequate signs, barricades, flag persons, lights and other control devices in accordance with the provisions and requirements of the SCDOT standards. No lanes of traffic shall be closed without prior approval.
7. Provide erosion and sediment control to minimize erosion and the transport of sediment beyond the limits of the work area.
8. Anticipate that portions of the jacking and boring excavation will be below the groundwater table and dewatering will be required.
9. Comply with all local, state, and federal laws, rules, and regulations at all times to prevent pollution of the air, ground, and water.
10. Locate, mark and protect existing utilities and facilities in the work area. Perform test pits as required.

11. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from ENGINEER in writing, before proceeding.

B. Jacking and Boring Operations:
   1. Provide and maintain adequate boring equipment and install support systems as required.
   2. The boring operations shall consist of excavating the embankment material ahead of the casing, removing excavated material through the pipe and forcing the pipe through the embankment with jacks into the spaced provided. No jetting, sluicing, or wet boring is permitted.
   3. Required launching and receiving pits/shafts shall be excavated and maintained to the minimum dimensions necessary to perform the operations and allow for safe working practices.
   4. The pits or shafts shall be adequately barricaded, sheeted, braced, dewatered, and ventilated as required, in accordance with applicable specifications and regulations.
   5. CONTRACTOR to use thrust blocks designed to distribute loads in a uniform manner so that any deflection of the thrust block is uniform and does not impart excessive load on the shaft itself or cause the jacking frame to become misaligned.
   6. Position jacks so that the resultant force is applied along the centerline of the casing pipe, and force is applied evenly to the entire end of the pipe.
   7. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage.
   8. CONTRACTOR to monitor and control the jacking pressure/force applied to ensure that pipe manufacturer’s recommended limits are not exceeded.
   9. CONTRACTOR responsible for all testing, survey, and documentation of the pre/post construction site conditions, in which to provide as a basis of comparison for the post construction conditions to be evaluated.
   10. Once jacking has begun, the operation must continue without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

C. Steel Casing Installation
   1. The installation of the casing shall be in accordance with manufacturer’s recommendations and subject to the approval of the agency having jurisdiction.
   2. The casing pipe shall be adequately protected to prevent crushing or other damage under the jacking pressures. Provide timbers for cushioning between the pipe pushed end and the jacking equipment.
   3. The casing installation shall produce NO upheaval, settlement, cracking, movement, or distortion of the existing roads.
   4. Install casing piping concurrent with the bore, as earth is removed.
   5. After the installation of the casing piping, the CONTRACTOR shall inject grout through the grout connections in such a manner as to completely fill all voids outside the casing pipe resulting from the jacking and boring operations. Grout pressure shall be controlled and monitored, so as to avoid deformation of the steel casing and avoid movement of the surrounding ground. After completion of the grouting operations, the grout connections shall be closed with cast-iron threaded plugs.

D. Carrier Pipe Installation
   1. All joints of the carrier piping, within the casing, shall be restrained in accordance with the Section 40 05 19, Ductile Iron Process Pipe or Section 40 05 31, Thermoplastic Process Pipe.
   2. Clean all dirt and debris from the casing piping.

3. Attach the centered/restrained casing spacers/guides to the carrier pipe sections, as required to prevent excessive sag, bending, shear stress and to support the pipe barrel in accordance with pipe manufacturer's recommendations. Piping is NOT to be supported by bells/joints.
4. Provide casing spacers at each joint, 6-inches from each side of joint, and at minimum 10-feet intervals, or as recommended by manufacturer. There shall be a minimum of two (2) casing spacers installed on each section of pipe.
5. Lubricant for pipe guides shall be drilling mud or flax soap. Petroleum, or Oil based products are NOT allowed.
6. The CONTRACTOR shall protect and preserve the interior surfaces of the steel casing from damage.
7. CONTRACTOR to provide casing end seals, and secure seals in place with stainless steel bands in accordance with the manufacturer's recommended procedures. The installation shall be watertight.

E. Transitions from One Type of Pipe to Another:
1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

3.2 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
1. Locations of existing piping shown should be considered approximate. Determine the true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by CONTRACTOR'S Work in any way.
2. Conform to applicable requirements of the General Conditions, and Section 01 73 29, Cutting and Patching, pertaining to cutting and patching. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations, pertaining to connections to existing facilities.

END OF SECTION

SECTION 33 11 00

WATER SERVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to furnish and install domestic water piping systems complete with accessories.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the domestic water piping systems Work.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation.
   2. Section 40 05 19, Ductile Iron Process Pipe.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. ANSI A13.1, Scheme for Identification of Piping Systems.
   2. ANSI B16.15, Cast Copper Alloy Threaded Fittings: Classes 125 and 150.
   3. ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   4. ANSI B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ASME B16.22).
   5. ANSI B16.23, Cast Copper Alloy Solder Joint Drainage Fittings: DWV.
   6. ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
   7. ANSI B16.29, Wrought Copper and Copper Alloy Solder-Joint Drainage Fittings: DWV.
   8. ANSI B16.39, Malleable Iron Threaded Pipe Unions: Classes 150, 250 and 350.
   9. ANSI B40.1, Gages – Pressure Indicating Dial - Elastic Element.
   10. ANSI H 23.1, Seamless Copper Water Tube, (ASTM B 88).
   11. ASSE 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
   12. ASSE 1018, Trap Seal Primer Valves – Water Supply Fed.
   13. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   14. ASTM B 32, Specification for Solder Metal.
   15. ASTM B 62, Specification for Composition Bronze or Ounce Metal Castings.
   16. ASTM B 88, Specification for Seamless Copper Water Tube.
   17. ASTM B 251, Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
   18. ASTM B 302, Specification for Threadless Copper Pipe, Standard Sizes.
   19. ASTM D 638, Test Method for Tensile Properties of Plastics.
   20. ASTM D 696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics between - 30°C and 30°C with a Vitreous Silica Dilatometer.

21. ASTM D 746, Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
22. ASTM D 790, Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
23. ASTM D 1238, Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
24. ASTM D 1248, Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
25. ASTM D 1330, Specification for Rubber-Sheet Gaskets.
26. ASTM D 1505, Test Method for Density of Plastics by the Density-Gradient Technique.
27. ASTM D 1525, Test Method for Vicat Softening Temperature of Plastics.
28. ASTM D 1598, Test Method for Time-to-Failure of Plastic Pipe under Constant Internal Pressure.
29. ASTM D 1603, Test Method for Carbon Black in Olefin Plastics.
30. ASTM D 1693, Test Method for Environmental Stress-Cracking of Ethylene Plastics.
31. ASTM D 2240, Test Method for Rubber Property-Durometer Hardness.
32. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
33. ASTM D 3261, Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
34. ASTM D 3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
35. ASTM F 1248, Test Method for Determination of Environmental Stress Crack Resistance (ESCR) of Polyethylene Pipe.
36. AWWA C511, Reduced-Pressure Principle Backflow Prevention Assembly.
37. AWWA C701, Cold-Water Meters – Turbine Type, for Customer Service.
38. AWWA C703, Cold-Water Meters – Fire-Service Type.
39. AWWA C901, Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch through 3-inch, for Water Service.
40. FS O-F-506, Flux, Soldering: Paste and Liquid.
41. FS WW-U-516, Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections.
42. NSF/ANSI 14, Plastics Piping Components and Related Materials.
43. NSF/ANSI 61, Drinking Water System Components – Health Effects.
44. South Carolina Department of Health and Environmental Control (SCDHEC), Notice of Approved Backflow Prevention Assemblies.
45. SCDHEC, State Primary Drinking Water Regulation 61-58.

1.3 QUALITY ASSURANCE

A. Installer's Qualifications:
   1. Engage a single installer regularly engaged in domestic water piping installation and with experience in the installation of the types of materials required; and who agrees to employ only tradesmen with specific skill and experience in this type of Work. Submit name and qualifications to ENGINEER.
   2. Engage a single installer for the entire domestic water piping system with undivided responsibility for performance and other requirements.

B. Regulatory Requirements: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. National Electrical Code, (NEC).
   2. South Carolina Department of Health and Environmental Control (SCDHEC).

C. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single domestic water piping systems manufacturer.
   2. The domestic water piping systems manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the domestic water piping systems manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Manufacturer's literature, illustrations, specifications and engineering data.
      b. Flexible connections.
      c. Other technical data related to the specified material and equipment as requested by ENGINEER.
      d. Gasket material.

B. Informational Submittals: Submit the following:
   1. Qualifications Statements:
      a. Installer’s qualifications.

C. Project Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. During progress of the Work keep an up-to-date set of the Drawings showing field and Shop Drawing modifications.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store all equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer’s recommendations for long-term storage.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace lost equipment or components and repair damage to new condition, in accordance with manufacturer’s instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Copper Water Tube:
   1. Tube:
      a. Reference: ANSI H23.1, ASTM B 88.
      b. Type: K or L.
      c. Temper: Hard-drawn or soft-annealed.
   2. Fittings:
      a. Soldered, reference: ANSI B16.18 for cast copper alloy or ANSI B16.22 for wrought copper and copper alloy.
      b. Soldered, drainage, reference: ANSI B16.23 for cast copper alloy or ANSI B16.29 for wrought copper and copper alloy.
      c. Flared, reference: ANSI B16.26.
      d. Threaded, reference: ANSI B16.15.
   3. Joints:
      a. Sweat:
         1) Solder Metal: ASTM B 32, Type 95-5TA.
         2) Flux: FS O-F-506, Type 1.
   4. Unions:
      a. Reference: FS WW-U-516.
      b. Material: Bronze.
      c. Rating: 250 lb. W.O.G.

B. High-Density Polyethylene (HDPE) Piping:
   1. HDPE piping system shall be specifically designed, constructed and installed for the potable water service.
   2. Physical Properties:
      a. Materials used for the manufacture of polyethylene pipe and fittings shall meet the following physical property requirements:

Property	Unit	Test Procedure	Value
Material Designation	-	PPI/ASTM	-
PPI Material Listing	-	PPI TR-4	PE 3408
Material Classification	-	ASTM D 1248	III C 5 P34
Cell Classification	-	ASTM D 3350	345434C or 355434C
Density	g/cm3	ASTM D 1505	>0.941
Melt Index (E)	g/10 min	ASTM D 1238	<0.15
Flexural Modulus	psi	ASTM D 790	>110,000
Tensile Strength	psi	ASTM D 638	<160,000
ESCR (C)	hours	ASTM D 1693	3,000 to 3,500
HDB	psi	ASTM D 2837	1,600 @ 23°C
UV Stabilizer (C)	percent carbon black	ASTM D 1603	2 to 3
Elastic Modulus	psi	ASTM D 638	110,000
Brittleness Temperature F		ASTM D 746	<-180
Vicat Softening Temp F		ASTM D 1525	255
Thermal Expansion in/in/ F		ASTM D 696	8 x 10E-5
Hardness	Shore D	ASTM D 2240	64
Molecular Weight Category	-	-	Extra-High

b. There shall be no evidence of splitting, cracking or breaking when the pipe is tested in accordance with Article 2.1.B.4, below.
c. Ring Stiffness Constant (RSC) values for the pipe can be directly related to the pipe's class designation. (Nominal RSC of Class 40 pipe = 40, etc.). The minimum RSC is 90 percent of the nominal.
d. The HDPE pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.
e. Clean rework or recycled material generated by the manufacturer's own production may be used as long as the pipe or fittings produced meet all the requirements of this Section.

3. Pipe and Fittings:
   a. Dimensions:
      1) Pipe Dimensions: The nominal inside diameter of the pipe shall be true to the specified pipe size in accordance with AWWA C901. Standard laying lengths shall be 50 feet ± 2-inches.

2) Fitting Dimensions: Fittings such as couplings, wyes, tees, adapters, etc. for use in laying pipe shall have standard dimensions that conform to ASTM D 3261.

b. Pipe and fittings shall be produced from identical materials, meeting the requirements of this Section, by the same manufacturer. Special or custom fittings may be exempted from this requirement.

c. Pipe and fittings shall be pressure rated to meet the service pressure requirements specified by ENGINEER. Whether molded or fabricated, fittings shall be fully pressure rated to at least the same service pressure rating as the pipe to which joining is intended.

d. Molded fittings shall meet the requirements of ASTM D 3261 and this Section. At the point of fusion, the outside diameter and minimum wall thickness of fitting butt fusion outlets shall meet the diameter and wall thickness specifications of the mating system pipe. Fitting markings shall include a production code from which the location and date of manufacture can be determined. The manufacturer shall provide an explanation of the production codes used.

e. Reducing tees with branch diameters of 16-inches or less shall be saddle tees.

f. Marking:

1) Each standard and random length of pipe and fitting in compliance with this standard shall be clearly marked with the following information.

a) ASTM or AWWA Standard Designation.
b) Pipe Size.
c) Class and Profile Number.
d) Production Code.
e) Standard Dimension Ratio (SDR).

4. Source Quality Control:

a. At a minimum, incoming polyethylene materials shall be inspected for density in accordance with ASTM D 1505 and melt flow rate in accordance with ASTM D 1238. All incoming polyethylene materials shall be certified by the supplier. Certification shall be verified by CONTRACTOR and ENGINEER. Incoming materials shall be approved by Manufacturer's Quality Assurance Program before processing into finished goods.

b. Representative samples of polyethylene materials shall be tested against the physical property requirements required herein. Each extrusion line and molding machine shall be qualified to produce pressure rated products by taking representative production samples and performing sustained pressure tests in accordance with ASTM D 1598.

c. Quality Assurance test for representative pipe and fitting samples shall include:

Test	Standard	Pipe	Fittings
Ring ESCR	ASTM F 1248	Yes	Not Applicable
Sustained pressure at 176°F/725 psi hoop stress (fo>100 h):	ASTM D 1598	Yes	Yes
Sustained pressure at 73°F/1,600 psi hoop stress (fo>1000 h):	ASTM D 1598	Yes	Yes

C. Dielectric Couplings:
    a. Refer to Section 33 05 06, Couplings, Adapters and Specials.

2.2 VALVES

A. Bronze Body Check Valves:
    1. Manufacturers: Provide products of one of the following:
        a. Ford Meter Box Company, Inc.
        b. Stockham Valves and Fittings Company.
        c. Lunkenheimer Company.
        d. Or equal.
    2. Type: Swing, regrinding bronze disc, screw-in cap.
    3. Materials: Brass and bronze.
    4. Rating: 150 lb. SWP.
    5. End Connections: Solder joint.

B. Bronze Body Ball Valves:
    1. Manufacturers: Provide products of one of the following:
        a. Stockham Valves and Fittings Company.
        b. Lunkenheimer Company.
        c. Or equal.
    2. Type: Non-blowout stem, adjustable packing gland, quarter turn, full port ball valve.
    3. Materials:
        a. Body: Cast bronze.
        b. Ball: Chrome plated brass.
        c. Packing and Seats: Teflon.
    4. Rating: 150 lb. SWP.
    5. End Connections: Screwed. Provide screwed to sweat adapters, where required.

C. Iron Body Gate Valves:
    1. Products and Manufacturers: Provide one of the following:
        a. Stockham Valves and Fittings, Fig. No. G-623.
        b. Lunkenheimer Company, Fig. No. 1430.
        c. American Cast Iron Pipe Company, Series 2500.
        d. M&H Valve Company, C509, C515.
        e. Mueller Company, LLC, 2360 Series.
        f. Or equal.
    2. Type: Rising stem, outside screw and yoke, solid wedge.
    3. Materials: Iron with bronze trim.
    4. Rating: 125 lb. SWP.
    5. End Connections: Threaded.

2.3 EQUIPMENT

A. Post Hydrants:
    1. Exposed Hose Connection, Non-Freeze Type:
        a. Manufacturers: Provide products of one of the following:
            1) Zurn Industries.

2) Or equal.
b. Type: Anti-siphon.
c. Materials:
1) Casing: Bronze.
2) Vacuum Breaker: Integral.
3) Threads: Two-inch hose thread outlet.
4) Wall Clamp: Adjustable with set screw.
5) Key: Removable tee handle type.
d. Connection: Two-inch sweat end inlet and 2-inch hose thread outlet, universal type.
e. Drain: 1/8-inch NPT drain hole.
f. Post Height to Hose Connection: 36-inches above finished ground elevation.

B. Backflow Preventers: 3/4-Inch to 2-Inches: Reduced Pressure Principle (RPP):
1. Products and Manufacturers: Provide from the most recent edition of SCDHEC List of Approved Backflow Prevention Devices, Reduced Pressure Principle Assemblies.
2. Type: Reduced pressure zone device with two independently acting check valves, together with an automatically operated pressure differential relief valve located between the two check valves.
3. Materials:
a. Body: Bronze.
b. Valve Discs: BUNA-N rubber.
c. Diaphragm: Silicone rubber or Buna-N rubber.
d. Springs: Stainless steel.
e. Screws: Stainless steel.
4. Maximum Working Pressure: 150 psi.
5. End Connections: Threaded.
6. Accessories:
a. Strainer with blow-off on inlet.
b. Ball valves on inlet and outlet.
c. Reduced pressure principle backflow preventer test kit for each unit furnished, provided in molded plastic carrying case with foam inserts.
7. References: ASSE 1013, AWWA C511 and authority having jurisdiction at the Site.

C. Backflow Preventers: 3-Inches and Larger: RPP:
1. Products and Manufacturers: Provide from the most recent edition of SCDHEC List of Approved Backflow Prevention Devices, Reduced Pressure Principle Assemblies.
2. Type: Reduced pressure zone device with two independently acting check valves, together with an automatically operated pressure differential relief valve located between the two check valves.
3. Materials:
a. Body: Bronze or cast-iron.
b. Valve Discs: Buna-N rubber.
c. Diaphragm: Silicon rubber or Buna-N rubber.
4. Maximum Working Pressure: 175 psi.
5. End Connections: Threaded or flanged.
6. Accessories:
a. Strainer with blow-off on inlet.
b. Outside screw and yoke gate valves on inlet and outlet.

c. Reduced pressure principle backflow preventer test kit for each unit furnished with carrying case, provided in molded plastic carrying case with foam inserts.

7. References: ASSE 1013, AWWA C511 and authority having jurisdiction at the Site

D. Backflow Preventers: DCV:
1. Products and Manufacturers: Provide from the most recent edition of SCDHEC List of Approved Backflow Prevention Devices, Double Check Valve Assemblies.
2. Type: Assembly of two single independently acting check valves with tight closing shut off valves at each end and suitable connections for testing the water tightness of each check valve.
3. Materials:
   a. Body: Bronze.
   b. Valve Discs: Silicon rubber.
   c. Springs: Stainless steel.
   d. Poppets: Glass-filled Celcon.
   e. Replaceable Seats: Glass-filled Noryl.
   f. Fasteners: Stainless steel.
   g. Test cocks: Bronze, four required.
4. Maximum Working Pressure: 150 psi.
5. End Connections: Threaded or Flanged.
6. Accessories:
   a. Ball valves or gate valves as shown on the drawings, on inlet and outlet with UL listed, FM approved tamper switches.
   b. DCV backflow preventer test kit provided in molded plastic carrying case with foam inserts for each unit furnished to be turned over to the OWNER.
      1) Products and Manufacturers: Provide one of the following:
         a) CMB Industries, Inc., Febco Division, Double Check Valve Backflow Prevention Assembly Differential Pressure Test Kit with carrying case.
         b) Watts Regulator, Backflow Preventer Test Kit with carrying case.
         c) Or equal.
7. Reference: Underwriters Laboratory listed, Factory Mutual approved.
8. Fire protection system backflow preventers shall be provided with a bypass assembly consisting of a water meter, approved double check valve backflow prevention assembly with shut-off valves and test cocks.

E. Water Meters for 3/4 - to 2-inch Water Services:
1. Type: Magnetic drive, disk water meter.
2. Products and Manufacturers: Provide one of the following:
   a. Mueller Systems LLC, MVR series.
   b. Neptune Technology Group Inc, T-10.
   c. Or equal.
3. Materials:
   a. Body: Bronze.
   b. Register: Brass.
4. Maximum Working Pressure: 150 psi.
5. End Connections: Threaded.
6. Meters shall conform to AWWA C701.

F. Water Meters for 3- and 4-inch Water Services:
1. Type: Magnetic drive, disk water meter.

a. Products and Manufacturers: Provide one of the following:
   1) Mueller Systems LLC, MVR series.
   2) Or equal.
b. Materials:
   1) Body: Bronze.
   2) Register: Brass.
c. Maximum Working Pressure: 150 psi.
d. End Connections: Flanged.
e. Meters shall conform to AWWA C701.

G. Water Meters for Fire-Services:
   1. Products and Manufacturers: Provide one of the following:
      a. Mueller Systems LLC, Model FM3.
      b. Or equal.
   2. Type: Magnetic drive, disk water meter.
   3. Materials:
      a. Body: Ductile iron or bronze.
   4. Size: 3-, 4-, 6-, 8- and 10-inch.
   5. Maximum Working Pressure: 175 psi.
   6. End Connections: Flanged.
   7. Meters shall conform to AWWA C703.

2.4 PIPE MARKING

A. Mark or label all materials with the following:
   1. Metal or alloy designation.
   2. Temper.
   3. Size and schedule.
   4. ASTM reference standard number.
   5. Name and location of supplier.

2.5 PAINTING

A. Piping and accessories shall be painted in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Install all items as shown, specified, and as recommended by the manufacturers.
   2. Request instructions from ENGINEER, in writing, when there is a conflict between the manufacturer's recommendations and the Contract Documents.
   3. Present conflicts between piping systems and/or equipment and/or structures to ENGINEER, in writing, who will determine corrective measures to be taken.
   4. Do not modify structures to facilitate installation of piping, unless specifically approved by ENGINEER.

5. Installation shall conform to requirements of all local and state codes.
6. Properly plug or cap the open ends of all piping at the end of each day's Work or other stopping point through construction. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical damage.
7. Refer to Section 33 05 05, Buried Piping Installation.

B. HDPE Piping:
   1. Heat Fusion of Pipe:
      a. HDPE pipe and fittings joints shall be heat fused by a qualified technician; trained by the manufacturer's representative in accordance with the manufacturer's recommended fusion procedures. Training must have occurred within the previous 12 months, or submittals verifying experience within the previous 12 months for all technicians performing heat fusion on polyethylene pipe and fittings.
      b. Weld in accordance with manufacturer's recommendation for butt fusion methods. Personnel operating fusion equipment shall be certified by the HDPE pipe manufacturer.
      c. The first butt fusion weld of each day's production welding and for each separate operator shall be tested by bent strap test method. No production welds shall be performed until successful completion of bent strap test.
      d. Butt fusion equipment for joining procedures shall be capable of meeting conditions recommended by HDPE pipe manufacturer including, but not limited to, temperature requirements, alignment, and fusion pressures. The equipment used for the heat fusion joints shall be capable of recording the heating and fusion pressures used to join the HDPE pipe, recording heater temperature, and storing this information for future retrieval (data logger). Each field fusion shall be recorded by such equipment and this information shall be made compiled into daily log reports. Log reports shall be submitted to CONTRACTOR and ENGINEER daily. Reports shall also include the results of the bent strap tests.
      e. For cleaning pipe ends, solutions such as detergents and solvents, when required, shall be used in accordance with manufacturer's recommendations.
      f. Do not bend pipe to greater degree than minimum radius recommended by manufacturer for type and grade. Shop Drawings shall address locations and deflections of required fittings to prevent installation that exceeds a greater degree of bending than the manufacturer's recommended minimum bending radius for each size and class of HDPE pipe.
      g. Do not subject pipe to strains that will overstress or buckle piping or impose excessive stress on joints.
      h. Branch saddle fusions shall be joined in accordance with manufacturer's recommendations and procedures. Branch saddle fusion equipment shall be of size to facilitate saddle fusion within trench.
      i. Before butt fusing pipe, inspect each length for presence of dirt, sand, mud, shavings, and other debris or animals. Remove debris from pipe.
      j. Cover open ends of fused pipe at the end of each day's Work. Cap to prevent entry by animals or debris.
   2. Flange Jointing:
      a. Use on flanged pipe connection sections.
      b. Connect slip-on Type 316 stainless steel backup flanges with Type 316 stainless steel nuts and bolts.
      c. Butt fuse fabricated flange adapters to pipe.
      d. Observe following precautions in connection of flange joints.

1) Align flanges or flange/valve connections to provide tight seal. Require nitrile-butadiene gaskets if needed to achieve seal. Integral flange adapters and gaskets are required for flange/valve connections.
2) Place U.S. Standard round washers as may be required on some flanges in accordance with manufacturer's recommendations. Bolts shall be lubricated in accordance with manufacturer's recommendations.
3) Tighten flange bolts in sequence and accordance with manufacturer's recommendations. CAUTION: Do not over-torque bolts.

e. Pull bolt down by degrees to uniform torque in accordance with manufacturer's recommendation.
f. Install electrofusion couplers, where used, in accordance with manufacturer's specifications.

3. Pipe Placement:
a. Grade control equipment shall be of type to accurately maintain design grades and slopes during installation of pipe.
b. Dewatering: Remove standing water in trench before pipe installation.
c. Unless otherwise specifically stated, install pipe in accordance with manufacturer's recommendations.
d. Maximum lengths of fused pipe to be handled as one section shall be placed according to manufacturer's recommendations as to pipe size, pipe SDR, and topography so as not to cause excessive gouging or surface abrasion, but shall not exceed 400 feet.
e. Cap pipe sections longer than single joining (usually 50 feet) on both ends during placement, except during fusing operations.
f. Notify ENGINEER prior to installing pipe into trench and allow time for ENGINEER'S inspection.
1) Correct irregularities found during inspection.
g. Complete tie-ins within trench whenever possible to prevent overstressed connections.
h. Allow pipe sufficient time to adjust to trench temperature prior to testing, segment tie-ins or backfilling activity.
i. Pipe shall be snaked in trench to allow a minimum of 12-inches/100 feet for thermal contraction and expansion.
j. Allow extra length at future connection points to be cut to fit after backfill and prior to tie-in.

3.2 REDUCED PRESSURE ZONE BACKFLOW PREVENTION

A. Provide RPZ-BFP devices or air gap separation for high hazard cross connections, as defined by SCDHEC 61-58.7.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Fill all systems and fully test all equipment, valves, etc. in operation.
2. Check for excessive vibration while all systems are operating.
3. Installed systems and components shall not be released to OWNER, unless all systems have been tested by the CONTRACTOR and approved by the ENGINEER.
4. Refer to 33 05 05, Buried Piping Installation, for buried piping disinfection and testing.

B. Inspection:
   1. Examine areas to receive piping, valves and accessories for:
      a. Defects that adversely affect execution and quality of the Work.
      b. Deviations beyond allowable tolerances for piping, valves and accessories.
      c. Start the Work only when conditions are satisfactory.
   2. The ENGINEER reserves the right to reject or authorize replacement of piping and accessories found to defective.

3.4 ADJUSTING AND CLEANING

A. Adjusting:
   1. Adjust all controls for proper settings.
   2. While system is operable balance all equipment, valves, etc. to achieve design conditions.

B. Cleaning:
   1. Thoroughly clean all piping, fittings, valves, and accessories prior to installation.
   2. Remove all dirt, rust, dust, etc. from piping in preparation for painting.
   3. Remove and dispose of all debris and waste from the Site resulting from installation.

C. Refer to Section 33 05 05, Buried Piping Installation.

3.5 MATERIAL SCHEDULES

A. Piping:
   1. Use types of pipe and fittings as specified below, unless otherwise specified or shown.
   2. All potable water piping 2-1/2-inches and smaller run underground shall be soft-annealed copper Type “K” copper tubing.
   3. All underground water piping 3-inches and larger shall be cement-lined ductile iron pipe with mechanical joints.
   4. All valves for copper or brass piping shall be bronze bodied, unless otherwise specified.
   5. All valves for ductile iron piping shall be iron bodied, unless otherwise specified.
   6. Use “wrought copper” fittings for copper tubing.
   7. Use “butt welded” fittings for welded steel pipe connections.

END OF SECTION

SECTION 33 31 01

SEWER LATERALS AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install wastewater sewer laterals and appurtenances.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before the Work required under this Section.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation.
   2. Section 33 05 06, Couplings, Adapters and Specials

1.2 REFERENCES

A. Standards which may be referenced in this Section are:
   1. AWWA M41, Ductile-Iron Pipe and Fittings.
   2. AWWA C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   3. AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   4. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast.
   5. ASTM D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   6. ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems,
   7. ASTM D2665, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
   8. ASTM D2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
   9. ASTM D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   10. ASTM D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   11. ASTM F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   12. ASTM F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
   13. ASTM F1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
   14. ANSI/AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances.
   15. NSF/ANSI Standard 14, Plastics Piping System Components and Related Materials.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall be able to provide evidence of at least five installations of substantially similar products in satisfactory operation for at least five years.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Product Data:
      a. Product data sheet.
      b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of parts.

B. Informational Submittals: Submit the following:
   1. Certifications: Submit a certificate signed by the manufacturer of each product stating that the product complies with the applicable referenced standards.

1.5 DELIVERY, STORAGE AND HANDING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work.

B. Storage and Protection:
   1. Protect materials from corrosion and deterioration.
   2. Store equipment in covered storage off the ground and prevent condensation and in accordance with the manufacturer's recommendations for long-term storage.

PART 2 PRODUCTS

2.1 GENERAL

A. Sewer Laterals: Provide one of the following as conditions warrant:
   1. Less than 16-feet cover, SDR 35 with minimum ring stiffness of 46psi, or Schedule 40 PVC pipe conforming to ASTM D2665, NSF 14 and ASTM D2466.
      a. Fittings shall be socket type in accordance with ASTM D2466.
      b. Joining shall be through solvent cement in accordance with ASTM D2564.
   2. 16-feet of cover or greater, Ductile Iron pipe of pressure class 350 conforming to AWWA C151.
      a. Pipe interior shall have a cement-mortar lining of standard thickness according to AWWA C104.
      b. Pipe exterior shall have a bituminous coat a minimum of 1-millimeter thick.
      c. Joining shall be by rubber gaskets and in conformance with AWWA C111.
   3. Joints, PVC pipe joints shall be solvent cemented in accordance with ASTM D2855.

B. Sewer Lateral Wye Branches:
   1. Sewer lateral wye branches shall be the same type material as the sewer main, and shall conform to the applicable sewer pipe specifications.

C. Sewer Lateral Cleanouts: Provide cleanouts of same material as the lateral.

D. Sewer Lateral Cap: Provide HS-20 traffic-rated plugs.

E. Couplings: See Section 33 05 06, Couplings, Adapters and Specials.

F. Saddles:
   1. Provide saddles of ABS plastic, PVC, elastomeric PVC or approved equivalent.
   2. Connect saddles to vitrified clay pipe using epoxy sealant.
   3. Connect saddles to PVC pipe using a flat or profile gasket, as appropriate to the pipe, and minimum two stainless steel bands around the pipe and saddle.
   4. Connect the lateral to the saddle with a compression gasket, solvent weld adapter, and/or stainless steel band, as appropriate.

G. Sewer Cut-ins:
   1. Provide cast iron cut-ins where new sewer laterals are connected to existing sewer mains smaller than 36-inch (GENCO, Model D, Type K, DFW flexible saddle, pre-approved equivalent).
   2. For sewer cut-ins on 36-inch and larger sewer mains a Kor-N-Tee, Inserta-Tee or pre-approved equivalent shall be used.

PART 3 EXECUTION

3.1 INSTALLATION

A. 4-Inch and 6-Inch Laterals
   1. Connect laterals to the main with tees or wyes if the lateral is installed during construction with the main.
   2. Connect to existing mains with saddles placed in holes cored by an approved coring machine.
   3. Install laterals to the property line using 45-degree bends at the tee or saddle and pipe as shown in the Drawings.
   4. Install laterals that will discharge at terminal ends of the sewer main at 2% slope. Install all other laterals with a minimum slope of 1/8-inch per foot (1%).
   5. Cap the end of the lateral to be water/air tight.
   6. Encase all tees, saddles and bends shall be completely in #67 washed stone.
   7. Cut an “S” in the curb at the location where lateral crosses under curb.
   8. In subdivisions constructed without curb, paint a green “S” on the edge of pavement at the location where the lateral crosses under the edge of pavement.
   9. Connect to the sewer main all laterals except those serving lots adjacent to in line manholes or upstream from dead-end manholes in cul-de-sacs.
   10. Laterals connected to manholes shall be laid on a line from the center of the lot to the center of the manhole and shall extend not more than three inches inside the manhole wall.
   11. Manholes in cul-de-sacs shall have a maximum of 3 laterals. Any in line manhole shall have a maximum of 4 laterals.
   12. The lateral elevation entering the manhole shall match crown to crown with the main entering the manhole and a trough shall be formed for the lateral invert.
   13. Laterals that are connected to outfall lines shall enter the manhole at the shelf and an invert shall be formed to carry the lateral flow to the main invert.

14. Install laterals with a minimum of 4-feet of cover at the property line, unless otherwise approved by York County Water/Sewer Department. Install laterals with a maximum of 5-feet unless greater depth of the lateral installation is approved by a York County Inspector.

B. 8-Inch and Larger Laterals
   1. Connect 8-inch and larger diameter laterals to manholes with the lateral crown level with the crown of the main line pipe, or with outside drops, in accordance with the Drawings.
   2. When the lateral is the same diameter as the main line pipe, provide a drop of 0.2 feet in the manhole between the invert of the lateral and the invert of the main line pipe.
   3. Provide a minimum slope of 1/8-inch per foot (1%).

C. Install sewer laterals to be perpendicular to the mainline when possible.

D. Cleanouts shall be installed at the roadway right-of-way or easement line.

E. Install all sewer laterals and appurtenances in accordance with Section 33 05 05, Buried Piping Installation.

END OF SECTION

SECTION 40 05 05

EXPOSED PIPING INSTALLATION

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment and incidentals as shown, specified, and required to install and test all exposed piping, fittings, and specials. The Work includes the following:
      a. All types and sizes of exposed piping, except where exposed piping installations are specified under other Sections.
      b. Unless otherwise shown or specified, this Section includes all piping beginning at the outside face of structures or structure foundations and extending into the structure. Piping embedded in concrete within a structure or foundation shall be considered as exposed and is included herein. Piping that is permanently or intermittently submerged, or installed in sub-aqueous environments, is considered as exposed and is included in this Section.
      c. Work on or affecting existing exposed piping.
      d. Installation of all jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all Work required for a complete exposed piping installation.
      e. Supports, restraints, and other anchors.
      f. Field quality control, including testing.
      g. Cleaning.
      h. Incorporation of valves, meters, and special items shown or specified into the piping systems per the Contract Documents and as required

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before exposed piping Work.
   2. Coordinate with appropriate piping Sections of Division 40.

C. Related Sections:
   1. Section 40 05 07, Pipe Hangers and Supports.
   2. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ASME Boiler and Pressure Vessel Code.
   2. ASME B31.3, Process Piping.
   3. American Society for Non-Destructive Testing (ASNT), ASNT-TC-1A, Recommended Practice, Personnel Qualification, and Certification in Non-destructive Testing.
   4. ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   5. ASTM B32, Specification for Solder Metal.
   6. ASTM D4174, Standard Practice for Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems.
   7. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

8. ANSI/AWWA C600, Installation of Ductile Iron Water Mains and Their Appurtenances.
9. AWWA M41, Ductile-Iron Pipe and Fittings.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with requirements and recommendations of authorities having jurisdiction over the Work, including:
      a. York County.
      b. South Carolina Department of Transportation.
      c. South Carolina Department of Health and Environmental Control.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings in plan and, as applicable, section.
      b. Details of piping, valves, supports, accessories, specials, joints, harnessing, and main anchor supports, and connections to existing piping, structures, equipment, and appurtenances.
      c. Laying schedules for piping with restrained joints.
   2. Testing Plans, Procedures, and Testing Limitations:
      a. Submit description of proposed testing methods, procedures, and apparatus, and obtain ENGINEER's approval prior to testing.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit a certificate, signed by manufacturer of each product, certifying that product complies with applicable referenced standards.
   2. Source Quality Control Submittals:
      a. Submit copies of testing report for each test.
   3. Site Quality Control Reports:
      a. Submit copies of testing report for each test.

C. Closeout Submittals: Submit the following:
   1. Record Documentation:
      a. Maintain accurate and up-to-date record documents showing field and Shop Drawing modifications. Record documents for exposed piping Work shall show actual location of all piping and appurtenances on a copy of the Drawings, unless otherwise approved by ENGINEER.
      b. Record documents shall show piping with elevations referenced to the project datum and dimensions from permanent structures. For straight runs of pipe provide offset dimensions as required to document pipe location.
      c. Include section drawings with exposed piping record documents when the Contract Documents include section Drawings.
      d. Conform to Section 01 78 39, Project Record Documents.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery:
   1. Deliver products to Site to ensure uninterrupted progress of the Work.

2. Upon delivery, inspect pipe and appurtenances for cracked, gouged, chipped, dented, and other damage and immediately remove damaged products from Site.
3. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

B. Storage:
1. Store products for convenient access for inspection and identification. Store products off the ground using pallets, platforms, or other supports. Protect packaged products from corrosion and deterioration.
2. Pipe and fittings materials may be stored outdoors without cover.
3. Conform to requirements of Section 01 66 00, Product Storage and Handling Requirements.

C. Handling:
1. Handle pipe, fittings, specials, and accessories carefully with approved handling devices. Do not drop or roll material of delivery vehicles. Do not otherwise drop, roll, or skid piping.
2. Avoid unnecessary handling of pipe.
3. Keep pipe interiors free of dirt and foreign matter.
4. Protect interior linings and exterior coatings of pipe and fittings from damage. Replace pipe and fittings with damaged lining regardless of cause of damage. Repair damaged coatings.
5. Conform to requirements of Section 01 65 00, Product Delivery Requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Piping materials are specified in the Exposed Piping Schedule at the end of this Section. Piping materials shall conform to Specification for each type of pipe and piping appurtenances in applicable sections of Division 40, Process Integration.

B. Markings and Identification:
1. Pipe Markings:
a. Clearly mark each piece of pipe or fitting with a designation conforming to that shown on the approved Shop Drawings.
b. Manufacturer shall cast or paint on each length of pipe and each fitting the pipe material, diameter, and pressure or thickness class.
2. Pipe Identification Markers and Arrows: Refer to Section 40 05 19, Ductile Iron Process Pipe.

C. Appurtenances: Provide products that comply with:
1. Section 40 05 07, Pipe Hangers and Supports.
2. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which the Work is to be installed and notify ENGINEER in writing of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install piping as shown, specified and as recommended by the pipe and fittings manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Contract Documents, request in writing instructions from ENGINEER before proceeding.
   3. Provide pipe manufacturer's installation specialist at Site as specified on this Section.

B. Temporary Blind Flanges, Plugs, Caps, and Bulkheads:
   1. Temporarily plug installed pipe at the end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
   2. Install standard plugs in all bells at dead ends, tees, and crosses. Cap all spigot and plain ends.
   3. Fully secure and block blind flanges, plugs, caps, and bulkheads installed for testing, designed to withstand specified test pressure.
   4. Where plugging is required for phasing of Work or subsequent connection of piping, install watertight, permanent type blind flanges, plugs, caps, or bulkhead acceptable to ENGINEER.

C. Piping Installation:
   1. Conform to manufacturer's instructions and requirements of standards and manuals listed in this Section, as applicable:
      a. Ductile Iron Pipe: ANSI/AWWA C600, AWWA M41.
   2. Install straight runs true to line and elevation.
   3. Install vertical pipe truly plumb in all directions.
   4. Install piping parallel or perpendicular to walls of structures. Piping at angles and 45 degree runs across corners of structures will not be accepted unless specifically shown on the Contract Documents or approved by the ENGINEER.
   5. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, and other obstructions.
   6. Install piping to leave all corridors, walkways, work areas, and similar spaces unobstructed. Unless otherwise approved by ENGINEER provide a minimum headroom clearance under piping and pipe supports of 7.5 feet. Clearances beneath piping shall be measured from the outermost edge of piping, flanges or other type of joint that extends beyond the nominal outside diameter of piping.
   7. Cutting: Cut pipe from measurements verified at Site. Field cut pipe, where required, with a machine specially designed for cutting type of pipe being installed. Make cuts carefully without damage to pipe, coating, or lining, and with a smooth end at right angles to axis of pipe. Cut ends of push-on joint type pipe shall be tapered and sharp edges filed off smooth. Do not flame-cut pipe.

D. Jointing Pipe:
   1. General:

a. Make joints in accordance with pipe manufacturer's recommendations and Contract Documents.
b. Cut piping accurately and squarely and install without forcing or springing.
c. Ream out pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts.
d. Remove all cuttings and foreign matter from inside of pipe and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

2. Ductile Iron Flanged Joints:
   a. Assemble flanged joints using ring-type gaskets, with thickness as recommended by pipe manufacturer but not less than 1/8-inch thick, for raised-face flanges. Use full-face gaskets for flat-face flanges, unless otherwise approved by ENGINEER or recommended by pipe manufacturer. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
   b. Tighten bolts in a sequence that provides equal distribution of bolt loads.
   c. Length of bolts shall be uniform. Bolts shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. Machine-cut ends of bolts to be neatly rounded. Do not use washers.
   d. Prior to assembly of flanged joints, lubricate bolt threads and gasket faces.
   e. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.
   f. After assembly, coat all bolts and nuts, except stainless steel bolts and nuts, with coating appropriate for pipe and fittings being joined, as recommended by manufacturer.
3. Copper Tubing Joints:
   a. Soldered Joints:
      1) Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B32.
      2) Ream or file pipe to remove burrs.
      3) Clean and polish contact surfaces of joints.
      4) Apply flux to both male and female ends.
      5) Insert end of tube into full depth of fitting socket.
      6) Heat joint evenly.
      7) Form continuous solder bead around entire circumference of joint starting at the bottom.
   b. Threaded Joints:
      1) When open flames for soldering are impractical, or at unions and connections to equipment and appurtenances, assemble copper tubing with flared ends as permitted by authority having jurisdiction.
      2) Ends of tubing shall be flared at an angle of 45 degrees with flaring tool recommended by pipe manufacturer. Flaring tool shall have same outside diameter as tube to be flared.
      3) Tubing to be flared shall be soft temper or annealed prior to flaring.
      4) Cut end of tube square and ream to remove burrs.
      5) Resize back to round tube that is out-of-round.
      6) Clean and polish contact surfaces of joints using an abrasive cloth.
      7) Place flare nut over end of tube with threads closest to end being flared.
      8) Insert appropriate length of tube between flaring bar of flaring tool and position yolk with flaring cone over tube end and clamp yoke in place.
      9) Turn handle of yolk clockwise without over-tightening. Cracked or deformed tubes will be rejected.

10) Do not apply jointing compounds to mating surfaces of flare fitting and flared tube end before attaching flare nut to threaded connection.

4. Mechanical Coupling Joints:
   a. Mechanical couplings include sleeve-type flexible couplings, split flexible couplings, and other mechanical couplings used.
   b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with a wire brush to remove foreign matter.
   c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, joint is complete and further tightening is not required.

E. Installing Valves and Accessories:
   1. Provide supports for large valves, flow meters, and other heavy items as shown or required to prevent strain on adjoining piping.
   2. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the flow measuring device manufacturer, unless specific location dimensions are shown.
   3. Position swing check valves and butterfly valves so that they do not conflict with upstream and downstream elements of the piping system.

F. Unions:
   1. Install dielectric unions as specified in Section 33 05 06, Couplings, Adapters, and Specials**,** where dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
   2. Provide a union downstream of each valve with screwed connections.
   3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

G. Transitions from One Type of Pipe to Another:
   1. Provide all necessary adapters, specials, and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

H. Closures:
   1. Provide closure pieces, such as blind flanges and caps, shown or required to complete the Work.

3.3 THRUST RESTRAINT

A. Provide thrust restraint on all pressure piping systems and where otherwise shown or specified.

B. Thrust restraints shall be designed for axial thrust exerted by test pressure specified in the Exposed Piping Schedule at end of this Section.

3.4 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown on Drawings is approximate.

2. Determine the true location of existing piping to which connections are to be made, crossed, and that could be disturbed, and determine location of other facilities that could be affected by the Work.

B. Taking Existing Pipelines Out of Service:
   1. Conform to Section 01 14 16, Coordination with Owner's Operations.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines and tools specifically designed for cutting or tapping pipelines.
   2. Install temporary plugs to prevent entry of mud, dirt, water, and debris into pipe.
   3. Provide necessary adapters, sleeves, fittings, pipe, and appurtenances required to complete the Work.
   4. Conform to applicable requirements of Section 01 14 16, Coordination with Owner's Operations.

3.5 PAINTING

A. Surface preparation, priming, finish painting, and touch-up painting shall conform to the manufacturer's paint standards.

3.6 FIELD QUALITY CONTROL

A. Testing, General:
   1. Test all piping, except as exempted in the Exposed Piping Schedule.
   2. Notification:
      a. Notify ENGINEER at least 48 hours prior to testing.
      b. When authorities having jurisdiction are to witness tests, notify ENGINEER and authorities having jurisdiction in writing at least 48 hours in advance of testing.
   3. Conduct all tests in presence of ENGINEER.
   4. Remove or protect pipeline-mounted devices that could be damaged by testing.
   5. Provide all apparatus and services required for testing, including:
      a. Test pumps, compressors, hoses, calibrated gages, meters, test containers, valves, fittings, and temporary pumping systems required to maintain OWNER's operations.
      b. Temporary bulkheads, bracing, blocking, and thrust restraints.
   6. Provide air if an air test is required, power if pumping is required, and gases if gases are required.
   7. Unless otherwise specified, OWNER will provide fluid required for hydrostatic testing. CONTRACTOR shall provide means to convey fluid for hydrostatic testing into the pipe being tested. CONTRACTOR shall provide fluid for other types of testing required.
   8. Repair observed leaks and repair pipe that fails to meet acceptance criteria. Retest after repair.
   9. Unless otherwise specified, testing shall include existing piping systems that connect with new piping system. Test existing pipe to nearest valve. Piping not installed by CONTRACTOR and that fails the test shall be repaired upon authorization of ENGINEER or OWNER. Repair of existing piping will be paid as extra work unless otherwise specified.

B. Test Schedule:
   1. Refer to the Exposed Piping Schedule for type of test required and required test pressure.
   2. Unless otherwise specified, the required test pressures are at lowest elevation of pipeline segment being tested.

3. For piping not listed in Exposed Piping Schedule:
    a. Hydrostatically test pipe that will convey liquid at a pressure greater than five psig.
4. Test Pressure:
    a. Use test pressures listed in Exposed Piping Schedule.
    b. If test pressure is not listed in Exposed Piping Schedule, or if a test is required for piping not listed in the Exposed Piping Schedule, test pressure will be determined by the ENGINEER based on the maximum anticipated sustained operating pressure and the methods described in the applicable ANSI/AWWA manual or standard that applies to the piping system.

C. Hydrostatic Testing:
1. Preparation for Testing:
    a. Follow procedures described in AWWA Manual M9. A wetting period is not required for pipe that is not cement mortar-lined.
    b. Prior to testing, ensure that adequate thrust protection is in place and all joints are properly installed.
    c. Piping for Hydraulic Fluid, Lube Oil, and Diesel Fuel: Hydrostatically test system using the fluid with which system will function permanently. Allowable leakage is zero. For fluid power systems, manufacturer shall supervise installation and testing of system components, including field piping.
2. Test Procedure:
    a. Fill pipeline slowly to minimize air entrapment and surge pressures. Fill rate shall not exceed one foot of pipe length per second in the pipe being tested.
    b. Expel air from pipe as required. Obtain approval of ENGINEER prior to tapping pipe for expelling air.
    c. Examine joints and valves, and make repairs to eliminate visible leakage.
    d. After specified wetting period, add fluid as required to pressurize line to required test pressure. Maintain test pressure for a stabilization period of ten minutes before beginning test.
    e. Timed test period shall not begin until after the pipe has been filled, exposed to the required wetting period, air has been expelled, and pressure stabilized.
    f. Timed Test Period: After the stabilization period, maintain test pressure for at least two hours. During timed testing period, add fluid as required to maintain pressure within five psig of required test pressure. The test pressure shall then remain steady for one hour, indicating no leakage.
    g. Pump from a test container to maintain test pressure. Measure volume of fluid pumped from test container and record on test report. Record pressure at test pump at fifteen minute intervals for duration of test.
3. Allowable Leakage Rates: Leakage is defined as the quantity of fluid supplied to pipe segment being tested to maintain pressure within five psi of the test pressure during timed test period. Allowable leakage rates for piping are:
    a. No Leakage: Pipe with flanged, threaded, soldered, or brazed joints.
    b. Rates based on formula or table in AWWA Manual M41:
        1) Metal and fiberglass pipe joined with rubber gaskets as sealing members, including the following joint types:
            a) Bolted sleeve type couplings.

D. Process Air Pipe Testing:
1. General:
    a. Required test pressure is listed in Exposed Piping Schedule.
2. Preparation for Testing:

a. Provide temporary tie rods at expansion joints as required.
b. Verify that pipe supports, where present, are secure.
c. Test one pipe segment at a time. Use temporary blind flanges and isolators as required.
d. Install corporation cocks for filling and relieving air. Provide temporary automatic pressure relief valve and pressure gauge with range suitable for test pressure.

3. Test Procedure:
   a. Pressurize pipe segment being tested with air to the required test pressure. Maintain pressure for at least two hours.
   b. Apply a soapy water solution to all joints to check for leakage, indicated by presence of bubbles, while test pressure is maintained.
   c. Allowable Leakage: Zero
4. Repair and retest pipelines that fail the test.
5. After testing is complete remove temporary measures provided for testing and provide Type 304 stainless steel threaded plugs at taps used for testing.

3.7 CLEANING

A. Cleaning, General: Clean pipe systems as follows:
   1. Thoroughly clean all piping, including flushing with water, dry air, or inert gas as required, in a manner approved by ENGINEER, prior to placing in service.
   2. Piping 24-inch diameter and larger shall be inspected from inside and debris, dirt and foreign matter removed.

B. Cleaning of Hydraulic and Fluid Power Oil Systems: Upon completion of field piping, but before connection to control components, hydraulic and fluid power oil systems shall be flushed and cleaned by circulating special flushing oil through the system. Flushing oil and procedures shall comply with ASTM D4174. System shall be cleaned such that internal contamination of system, when tested using procedures specified in SAE J1227, Section 2.3, shall not exceed the Allowable Cleanliness Level (ACL). Unless otherwise specified, ACL value shall be established by manufacturer of major hydraulic system components in accordance with SAE J1227, Section 9.1.

3.8 EXPOSED PIPING SCHEDULE

A. The schedules listed below, following the “End of Section” designation, are a part of this Specification section.
   1. Table 40 05 05-A, Exposed Piping Schedule.

END OF SECTION

TABLE
40 05 05-A, EXPOSED PIPING SCHEDULE

Service	Diameter (inch)	Material	Interior Lining	Exterior Coating	Pressure Class/ Thickness	Joint	Test	Remarks

The following abbreviations are used in the Exposed Piping Schedule.

A. Service Abbreviations

Service	Abbrev.		Service	Abbrev.
Sanitary Force Main	SFM		Fuel Oil	FO
Wastewater	WW			

B. Material Abbreviations

Material	Abbrev		Material	Abbrev.
Ductile Iron	DI			
Copper	C			

C. Lining/Coating Abbreviations

Lining	Abbrev		Coating	Abbrev.
Cement Mortar Lined	CL		Painted	P
Ceramic Epoxy	CE			

D. Joint Abbreviations

Joint Type	Abbrev		Joint Type	Abbrev.
Soldered	Sd		Flanged	Flg
Brazed	Bz		Flanged Adapter	FA

E. Test Abbreviations

Test	Abbrev		Test	Abbrev.
Hydrostatic Test (test pressure in psig)	HYD ( )		Exfiltration Test	EX

SECTION 40 05 07

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified and required to design, furnish, and install all hangers, supports and appurtenances necessary to complete the Work.

B. Coordination:
   1. Review installation procedures under other Sections and coordinate the installation of items that must be installed with the pipe hangers and supports Work.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 05 50 13, Miscellaneous Metal Fabrications.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM A 575, Specification for Steel Bars Carbon, Merchant Quality, M-Grades.
      b. ASTM E 84, Test Method for Surface Burning Characteristics of Building Materials.
   2. Federal Specification, (FS).
      a. S A-A-1192, Hangers, Pipe.
   3. Manufacturers Standardization Society of the Valve and Fittings Industry, (MSS).
      a. MSS SP 58, Pipe Hangers and Supports-Materials, Design and Manufacture.
      b. MSS SP 69, Pipe Hangers and Supports - Selection and Application.
   4. Underwriters' Laboratories, Inc., (UL).
      a. UL 203, Pipe Hanger Equipment for Fire Protection Service.

1.3 QUALITY ASSURANCE

A. Each type of pipe hanger or support shall be the product of one manufacturer.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single pipe hangers and supports manufacturer.
   2. The pipe hangers and supports equipment manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pipe hangers and supports equipment manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings showing all hangers and supports for each piping system specified. Shop Drawings shall show location, installation, material, loads or forces, and deflection of all hangers and supports.
      b. Each pipe system shall be analyzed for all loads and forces on the hangers and supports. Provide calculations of reaction forces to the structure to which they are fastened. Provide confirmation that hanger systems comply with support requirements and codes.
      c. Submit and coordinate these with Shop Drawings required for all piping systems.
   2. Product Data:
      a. Submit manufacturers' catalogs, literature, and engineering data on all hangers and supports. Load ratings, materials and installation shall be consistent with the recommendations of the MSS SP 58, MSS SP 69 and Federal Specification A-A-1192.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling and Unloading:
   1. Deliver materials to the Site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of that Work.

B. Storage and Protection:
   1. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
   2. Store materials in covered storage off the ground and prevent condensation.

C. Acceptance at Site:
   1. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the Site. CONTRACTOR shall notify ENGINEER, in writing, if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GENERAL

A. Hangers and supports shall meet with the following requirements:
   1. Standard and fabricated hangers and supports shall be furnished complete with necessary inserts, bolts, nuts, rods, washers, and other accessories.
   2. Generally, run piping in groups where practicable and parallel to building wall. Provide minimum clearance of 1-inch between pipe and other work.
   3. Install hangers or supports at all locations where pipe changes direction.
   4. All hangers and supports shall be capable of adjustment after placement of piping.

5. Different types of hangers or supports shall be kept to a minimum.
6. All suspended or supported ductile iron pipe shall have a hanger or support adjacent to each hub.
7. Support vertical piping at each floor and between floors by stays or braces to prevent rattling and vibration.
8. Hanger rods shall be straight and vertical. Chain, wire, strap or perforated bar hangers shall not be used. Hangers shall not be suspended from piping.
9. Maximum support spacing unless otherwise shown or approved for standard weight ductile iron pipe shall be as follows:
    a. Exposed pressure pipe shall not span longer than 12-feet without appropriate support.
    b. Exposed soil pipe shall not span longer than 10-feet without appropriate support.
    c. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
    d. Pipe hanger and support selection shall be as shown and in this Section.
10. Where proper hanger or support spacing does not correspond with joist or rib spacing, structural steel channels may be attached to joists or ribs and pipes suspended there from.
11. Supports and hangers shall be of a material that is compatible with the fluid being conveyed in such pipe being supported.
12. Anchors for pipe support systems shall be compatible or protected by a coating system which is compatible with the fluid being conveyed in such pipe being supported.

B. Expansion compensation shall be designed for individual exposed piping systems with the following Design Criteria:
1. $\Delta L = L \times \Delta T \times \alpha$
    a. Where ΔL = pipe length change (inches).
    b. L = pipe length between anchors (inches).
    c. ΔT = 100 (F).
    d. α = coefficient of thermal expansion (inches/inches/F).
2. Expansion compensation shall be designed as an integral part of the piping hanger, support and anchorage system.
3. Expansion compensation shall be achieved via expansion joints.

2.2 HANGERS AND SUPPORTS

A. Hangers and supports where shown shall be in accordance with detail drawings. Hangers and supports not shown shall be in accordance with MSS SP 58.

B. Products and Manufacturers: Provide products from one of the following:
1. Anvil International, Inc.
2. Elcen Metal Products Co.
3. Cooper Industries, B-Line.
4. Unistrut Corporation.
5. Or equal.

2.3 ACCESSORIES

A. Hanger rods shall be made from ASTM A 575, with square head nut on top and running thread on bottom end.

B. Concrete Inserts:
   1. Concrete inserts shall be MSS SP 58 malleable Type 18.
   2. Concrete inserts shall be of the continuous type capable of supporting the amount of force as shown on the Drawings.
   3. Manufacturers: Provide products of one of the following:
      a. Unistrut Corporation, Wayne, Michigan.
      b. Elcan Metal Products, Company, Franklin Park, Illinois.
      c. B-Line.
      d. Anvil International, Inc.
      e. Or equal.

C. Steel Beam Clamps:
   1. Steel beam clamps shall be of malleable iron and conform to MSS SP 58.

D. Inserts for Pipe Insulation:
   1. Insulated pipe, larger than 1-1/2-inches in diameter, shall be supported by a rigid insert to protect the insulation. A steel metal saddle of sufficient gauge to carry the weight of the pipe and its fluid without deforming shall extend 2-inches minimum on each side of the rigid insert. The joints between insert and insulation shall be sealed before saddle is installed. Sizes up to 6-inches IPS shall be MSS SP 58, Type 40, and for sizes over 10-inches shall be MSS SP 58, Type 39.

E. Brackets:
   1. Brackets for wall mounting shall conform to: MSS SP 58 Type 32 for medium welded steel bracket, Type 33 for heavy welded steel bracket and Type 34 for side beam support.

F. Fabricated Pipe Rack:
   1. Pipes shall be supported and anchored to the fabricated pipe rack as shown. Clamps, rollers, and supports for piping shall conform to the general requirements of MSS SP 69.

2.4 PAINTING

A. Clean and prime ferrous metal surfaces in the shop.

B. Field painting shall conform to manufacturer recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate hangers, supports, and accessories to support piping, valves, and at all concentrated loads.

B. Locate hangers, supports, and accessories within maximum span lengths specified to support continuous pipeline runs unaffected by concentrated loadings.

C. Locate hanger, supports to prevent vibration or swaying and to provide for expansion and contraction.
   1. Temperature differential specified in this Section.
   2. Support piping independently so that equipment is not stressed by piping weight or expansion.
   3. Uncoated Hangers, Rods and Supports: Dip in zinc chromate primer before installation.
   4. Hanger types for horizontal piping, except as noted and shown:
      a. Forged steel adjustable clevis type, rod support for all services.
      b. Slide Bases:
         1) Pipe stand, brackets, trapeze or other equivalent structural support.
         2) For piping 2-inches or larger.
      c. For pipe and covering provide:
         1) Saddles for rollers or slide bases.
         2) Protective shields or saddles for all other types of supports.
      d. Threaded Steel Rods:
         1) Two inch vertical adjustment with two nuts each end for positioning and locking.
         2) Size hanger rods according to the schedule below, unless otherwise noted:

Nominal Pipe (Inches)	Rod Diameter (Inches)
2 and less	3/8
2-1/2 to 3-1/2	1/2
4	5/8
6	3/4
8 through 12	7/8
14 through 18	1
20 through 30	1-1/4

         3) For Double Rod Hangers: One size smaller than above.
         4) Connection to Structure for Piping to 2-Inches: Concrete inserts, or expansion shields in shear into sides of beams.
         5) Connection to Structure for Piping 2-1/2-Inch or Larger: Concrete inserts, beam clamps or suitable bridging.
   5. Vertical Piping:
      a. Base Support: Base elbow or welded equivalent.
         1) Bearing plate on structural support.
      b. Guides not to exceed:
         1) 25 feet for piping to 2-inches.
         2) 36 feet for piping 2-1/2-inches or larger.
      c. Top Support:
         1) Special hanger or saddle in horizontal connection.
         2) Provisions for expansion.
      d. Intermediate Supports: Steel pipe clamp at floor.
         1) Bolted and welded to pipe.

2) Extension ends bearing on structural steel or bearing plates.

e. For Multiple Pipes: Coordinate guides, bearing plates and accessory steel.

D. Install items to be embedded before concrete placement.

E. Fasten embedded items securely to prevent movement during concrete placement.

F. Install hangers and support units on piping systems in accordance with manufacturer's recommendations.

G. Adjust hangers and supports and place grout for concrete supports to bring pipelines to specified elevations.

H. Bring all pipe systems up to operating pressures and temperatures. Cycle systems to duplicate operating conditions. Correct all support malfunctions.

END OF SECTION

SECTION 40 05 08

WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all floor pipes, pipe sleeves, wall pipes, other wall pieces, and escutcheons to complete the Work.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate with the installation of floor pipes, pipe sleeves, wall pipes, other wall pieces and escutcheons that must be installed with or within formwork, walls, partitions, ceilings and panels.

C. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 07 92 00, Joint Sealants.
   3. Section 33 05 05, Buried Piping Installation.
   4. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American National Standards Institute, (ANSI).
      a. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
      b. ANSI B16.4, Gray-Iron Threaded Fittings.
   2. American Water Works Association, (AWWA).
      a. AWWA C104 (ANSI A21.4), Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
      b. AWWA C110 (ANSI A21.10), Ductile-Iron and Gray-Iron Fittings, for Water.
      c. AWWA C111 (ANSI A21.11), Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
      d. AWWA C115 (ANSI A21.15), Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
      e. AWWA C151 (ANSI A21.51), Ductile-Iron Pipe, Centrifugally Cast, for Water.
      f. AWWA C200, Steel Water Pipe 6-Inches and Larger.

1.3 QUALITY ASSURANCE

A. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single wall pipes, floor pipes and pipe sleeves manufacturer.
   2. The wall pipes, floor pipes and pipe sleeves manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.

3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the wall pipes, floor pipes and pipe sleeves manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Detailed drawings and data on all wall and floor pipe, and pipe sleeves. Submit and coordinate these with Shop Drawings required for all piping systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wall and Floor Pipes:
   1. Material: Same as specified for the piping connected to wall or floor pipe, unless otherwise approved by ENGINEER.
   2. End Connections: As shown.
   3. Thickness: Same as specified for the piping connected to wall or floor pipe.
   4. Collars: Provide collars at mid-point of wall for anchorage and watertightness.
   5. Pipes ends shall be flush with wall face, unless otherwise shown.
   6. Drill and tap flanged ends and mechanical joint bells for studs. Provide studs of same material as connected piping, except submerged and buried studs shall be of Type 316 stainless steel.

B. Pipe Sleeves:
   1. Ferrous and Plastic Pipe: Use standard weight stainless steel pipe, unless otherwise shown.
   2. Copper Pipe: Use Type K hard drawn copper pipe, unless otherwise shown.

C. Cast Wall Sleeves:
   1. Material: Ductile iron furnished with integral wall collar.
   2. Dimensions: As required for mechanical joint pipe to pass through sleeve. Length as required.

D. Link Seals: Provide link type mechanical seals suitable for 20 psi working pressure, corrosive service and accessible from one side, with glass-reinforced nylon pressure plate and stainless steel bolts and nuts.
   1. Products and Manufacturers: Provide one of the following:
      a. Link-Seal, as manufactured by Thunderline Corporation.
      b. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Wall and Floor Pipes: Install as shown and in accordance with approved Shop Drawings.

B. Pipe Sleeves:
1. Use sleeves wherever pipes pass through walls, partitions, floors, and roofs, unless otherwise shown.
2. Extend all sleeves through floor slabs a minimum of 2-inches above finished floor.
3. Anchor sleeves to concrete and masonry walls as shown or otherwise approved.
4. All sleeves through walls shall be flush with wall face.
5. All pipe joints and annular spaces in exterior walls or walls subjected to hydrostatic pressure shall be completely watertight.
6. Use link type seals to seal sleeve against hydrostatic pressure. Size sleeves to provide annular space required to suit the link type mechanical seals that are used.
7. Do not install sleeves and pipes through structural members, unless specifically shown and approved by ENGINEER.
8. Size sleeves to provide annular space as follows:

Pipe Size	Sleeve ID Minus Pipe Or Insulation OD
Less than 2-inches	1/2-inches to 3/4-inches
2-inches to 4-inches	3/4 inches to 1-1/4-inches.
6-inches to 12-inches	1-1/4 inches to 2-inches
Over 12-inches	2-inches to 3-inches

END OF SECTION

SECTION 40 05 19

DUCTILE IRON PROCESS PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish ductile iron pipe and fittings.
   2. Extent of piping is shown on the Drawings. Piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, specify pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before ductile iron pipe Work.

C. Related Sections:
   1. Section 31 23 05, Excavation and Fill.
   2. Section 33 05 05, Buried Piping Installation.
   3. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
   2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).
   3. ASTM A193, Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   4. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
   5. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   6. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
   7. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
   8. ASTM B117, Practice for Operating Salt Spray (Fog) Apparatus.
   9. ASTM C283, Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
   10. ASTM D714, Test Method for Evaluating Degree of Blistering of Paints.
   11. ASTM D792, Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   12. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.
   13. ASTM E96, Test Methods for Water Vapor Transmission of Materials.
   14. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
   15. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings.
   16. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
   17. ANSI/AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
   18. ANSI/AWWA C110, Ductile Iron and Gray Iron Fittings for Water.

19. ANSI/AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
20. ANSI/AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
21. ANSI/AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
22. ANSI/AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
23. ANSI/AWWA C606, Grooved and Shouldered Type Joints.
24. European Standard (EN), EN 598: Ductile Iron Pipe, Fittings, Accessories and Their Joints for Sewerage Applications.
25. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
26. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
27. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
28. NSF/ANSI 61, Drinking Water System Components - Health Effects.
29. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
30. SSPC Painting Manual, Volume 1, Para. XIV.
31. SCDHEC, State Primary Drinking Water Regulation 61-58.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer:
      a. Manufacturer shall have a minimum of five years successful experience producing ductile iron pipe and fittings and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      b. Lining and coating products shall be manufactured by a firm with a minimum of five years successful experience in protecting pipelines exposed to the specified service conditions, and shall be able to show evidence of at least five installations in satisfactory operation in the United States that are similar applications to the specified service.
      c. When not applied by the manufacturer, lining and coating Subcontractor shall have a minimum of five years successful experience in the application of the specified linings and coatings for similar applications for the specified service, and shall be able to show evidence of at least five installations in satisfactory operation in the United States.

B. Supply and Compatibility:
   1. Unless otherwise approved, obtain all pipe, fittings, and appurtenances included in this Section from a single ductile iron pipe manufacturer.
   2. Ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and other submittals for pipe, fittings, and appurtenances furnished under this Section.
   3. Pipe, fittings, and appurtenances shall be suitable for the specified service and shall be integrated into overall piping system by ductile iron pipe manufacturer.
   4. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.

C. Regulatory Requirements:

1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with requirements of authorities having jurisdiction at Site.

1.4 SUBMITTALS

A. Action Submittals: Submit the following with Shop Drawings required under Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation:
   1. Shop Drawings:
      a. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings, and coatings.
   2. Samples:
      a. Submit Sample of pipe and fitting with each type of lining, for use at the Site to verify continuity, surface gloss, and color, as applicable, via visual inspection.
   3. Test Procedures: For linings and coatings in pipe and fittings.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit certificate signed by manufacturer of each product that product conforms to applicable referenced standards and the Contract Documents.
   2. Source Quality Control Submittals:
      a. Submit results of specified shop tests for pipe, fittings, linings, and coatings.
      b. Lining and coating test coupons.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Handling of Pipe and Fittings Lined with Ceramic Epoxy: Lifting devices shall not come into contact with lined surfaces. Use hooks, forks, chains, straps, and other lifting devices only on exterior of pipe and fittings. Pipe and fittings with damaged lining shall be replaced regardless of cause of damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
   1. Piping systems shall be suitable for their intended use.
   2. Joints shall be as specified in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not specified, provide flanged joints for exposed piping and push-on or mechanical joints for buried piping. Provide couplings on pipe with plain or grooved ends where shown or where approved by ENGINEER.

B. Ductile Iron Pipe, Joints, and Fittings:
   1. Flanged Pipe: Fabricate in accordance with ANSI/AWWA C115.
      a. Pressure Rating: As specified in piping schedule in Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Special Thickness Class 53 for three-inch

to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.

2. Non-Flanged Pipe: Conform to ANSI/AWWA C151 for material, pressure, dimensions, tolerances, tests, markings, and other requirements.
   a. Pressure Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation. If not otherwise specified, use Pressure Class 350 for 12-inch and smaller diameter pipe and Pressure Class 250 for 16-inch and larger diameter pipe .
   b. Special Thickness Class: As specified in piping schedules in Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation.
3. Pipe Joints:
   a. Flanged Joints: Conform to ANSI/AWWA C110 and ANSI/AWWA C111 capable of meeting the pressure rating or special thickness class, and test pressure specified in piping schedule in Section 40 05 05, Exposed Piping Installation.
      1) Gaskets: Unless otherwise specified, gaskets shall be at least 1/8-inch thick, ring or full-face as required for the pipe, of synthetic rubber compound containing not less than 50 percent by volume nitrile or neoprene, and shall be free from factice, reclaimed rubber, and other deleterious substances. Gaskets shall be suitable for the service conditions specified, specifically designed for use with ductile iron pipe and fittings.
      2) Bolts: Comply with ANSI B18.2.1.
         a) Exposed: ASTM A307, Grade B.
         b) Buried or Submerged: ASTM A193, Grade B8M, Class 2, Heavy hex, Type 316 stainless steel.
      3) Nuts: Comply with ANSI B18.2.2.
         a) Exposed: ASTM A563, Grade A, Heavy hex.
         b) Buried or Submerged: ASTM A194, Grade B8M, Heavy hex, Type 316 stainless steel.
   b. Mechanical Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure rating or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
      1) Glands: Ductile iron.
      2) Gaskets: Plain tip.
      3) Bolts and Nuts: High strength, low alloy steel.
      4) Manufacturers: Provide products of one of the following:
         a) Clow Water Systems Company.
         b) Atlantic States Cast Iron Pipe Company.
         c) Canada Pipe Company, Ltd.
         d) McWane Cast Iron Pipe Company.
         e) Pacific States Cast Iron Pipe Company.
         f) Griffin Pipe Products Co.
         g) American Cast Iron Pipe Co.
         h) U.S. Pipe and Foundry Co.
         i) Or equal.
   c. Push-On Joints: Comply with ANSI/AWWA C111 and ANSI/AWWA C151, capable of meeting pressure class or special thickness class, and test pressure specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
      1) Gaskets: Vulcanized SBR, unless otherwise specified.

2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.
3) Products and Manufacturers: Provide one of the following:
    a) Tyton or Fastite Joint by Clow Water Systems, Atlantic States Cast Iron Pipe Company, Canada Pipe Company, Ltd., McWane Cast Iron Pipe Company, Pacific States Cast Iron Pipe Company, and Griffin Pipe Products Company.
    b) Fastite Joint by American Cast Iron Pipe Company.
    c) Tyton Joint by U.S. Pipe and Foundry Company.
    d) Or equal.

d. Grooved End Joints: Comply with ANSI/AWWA C606.
1) Gaskets: Flush seal type designed for ductile iron that complies with or exceeds requirements of ASTM D2000
2) Bolts and nuts: As specified for flanged joints.
3) Unless otherwise specified, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
4) Products and Manufacturers: Provide one of the following:
    a) Victaulic, Style 31.
    b) Or equal.

e. Restrained Joints: Restrained push-on joints shall be capable of being deflected after full assembly. Field cuts of restrained pipe are not allowed without approval of ENGINEER.
1) Products and Manufacturers: Provide restrained joints for mechanical joint piping by one of the following:
    a) Megalug, Series 1100, by EBBA Iron Sales, Inc.
    b) MJ Coupled Joint, by American Cast Iron Pipe Co.
    c) MJ Field Lok, by U.S. Pipe and Foundry Co.
    d) Or equal.
2) Products and Manufacturers: Provide restrained joints for push-on joint piping by one of the following:
    a) Lok-Ring Joint, or Flex-Ring Joint, by American Cast Iron Pipe Co.
    b) TR Flex Joint, by U.S. Pipe and Foundry Co.
    c) Or equal.

4. Flanged and Push-On Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111. For compact fittings, comply with ANSI/AWWA C153.
    a. Material: Ductile iron.
    b. Pressure rating, gaskets, bolts, and nuts shall be as specified for flanged joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of the connected pipe. All fittings, including glands and bolts, shall be manufactured in domestic foundries.
5. Mechanical Joint Fittings: Comply with ANSI/AWWA C110 and ANSI/AWWA C111. For compact fittings, comply with ANSI/AWWA C153.
    a. Material: Ductile iron.
    b. Glands: Ductile iron.
    c. Pressure rating, gaskets, bolts, and nuts shall be as specified for mechanical joints. Pressure rating of fittings shall meet, but not exceed, specified pressure rating or special thickness class of connected pipe.
    d. Mechanical Joint Bolt Holes: Orient bolt holes to straddle vertical centerline of fittings as shown on the Drawings.
    e. All fittings, including glands and bolts, shall be manufactured in domestic foundries.

C. Lining, General:
   1. Typical Service Conditions:

Property	Buried Water	Buried Sanitary	Force Mains
Fluid(s) Conveyed Through Pipe	Potable Water	Sanitary Waste Water	Sanitary Waste Water
Lining Type	Cement Mortar	Cement Mortar	Ceramic Epoxy

   2. Surface Preparation:
      a. Surface Preparation: Prepare surface in accordance with recommended method.
      b. Finished Surface Inspection: Lining applicator shall inspect finished surface prior to application to determine acceptability. If surface is unacceptable, repeat surface preparation as necessary.

D. Cement-mortar Lining:
   1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be lined with bituminous seal coated cement-mortar lining in accordance with ANSI/AWWA C104.

E. Ceramic Quartz-Filled, Amine-Cured Novalac Epoxy Lining:
   1. Where specified in piping schedules included with Section 33 05 05, Buried Piping Installation and Section 40 05 05, Exposed Piping Installation, pipe and fittings shall be factory lined with a quartz-filled, amine-cured, novalac, epoxy containing at least twenty percent by volume of ceramic quartz pigment.
   2. Ceramic epoxy lining shall have a permeability rating of zero when tested according to Method A of ASTM E96, Procedure A, with a test duration of thirty days.
   3. Conduct the following tests on coupons from factory lined ductile iron pipe:
      a. ASTM B117 Salt Spray (scribed panel): Results to equal zero undercutting after two years.
      b. ASTM G95 Cathodic Disbondment 1.5 volts at 77 degrees F: Results to equal no more than 0.5 mm undercutting after thirty days.
      c. Immersion Testing rated using ASTM D714.
         1) Twenty Percent Sulfuric Acid: No effect after two years.
         2) Twenty-five Percent Sodium Hydroxide at 140 degrees F: No effect after two years.
         3) Distilled Water at 160 degrees F: No effect after two years.
         4) Tap Water at 120 degrees F (scribed panel): Zero undercutting after two years, with no effect.
   4. Ceramic epoxy lining shall have abrasion resistance of no more than four mils loss after one million cycles, in accordance with ES EN 598, Section 7.8, Abrasion Resistance.
   5. Within eight hours of surface preparation, interior of pipe and fittings shall receive 40 mils dry film thickness, utilizing method recommended by lining manufacturer that will comply with requirements of this Section. Number of coats applied shall be as recommended by lining manufacturer. Minimum substrate and ambient temperature for lining application shall be 40 degrees F.
   6. Inspection and Certification:
      a. Check all ductile iron pipe and fitting linings for thickness using magnetic film thickness gage in accordance with method in SSPC PA 2 Film Thickness Rating.

b. Test interior lining of pipe barrels and fittings for pinholes with non-destructive, 2,500-volt test. Defects found shall be repaired in accordance with lining manufacturer's recommendations prior to shipment from lining applicator's factory.
c. Mark each pipe and fitting with date of application and its numerical sequence of application.

7. Products and Manufacturers: Provide one of the following:
   a. Protecto 401 Ceramic Epoxy.
   b. Tnemec Perma-Shield 431.
   c. Or equal.

F. Couplings:
1. Refer to Section 33 05 06, Couplings, Adapters and Specials.

G. Specials:
1. Transition Pieces:
   a. Provide suitable transition pieces (adapters) for connecting to existing piping.
   b. Unless otherwise shown or indicated, expose existing piping to determine material, dimensions, and other data required for transition pieces.
2. Taps:
   a. Provide taps where shown or required for small-diameter piping or instrumentation connections.
   b. Provide corporation stops where shown or required.
   c. Allowable tap sizes are shown in Table 40 05 19-A. Provide tapping saddle with outlet joints conforming to requirements of this Section.

Table 40 05 19-A, Allowable Direct Tapping

Size (inch)	Pressure Class				
	150	200	250	300	350
	Maximum Allowed Direct Tap Size (inch)				
3	-	-	-	-	0.75
4	-	-	-	-	0.75
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1.25
14	-	-	1.25	1.5	1.5
16	-	-	1.5	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

   d. For flanged connections on tapping saddle outlet branch, counterbore flange in accordance with MSS SP-60 dimensions. Inside diameter of outlet shall be 1/4-inch greater than nominal diameter.
3. Tangential Outlets:
   a. Provide tangential outlet fittings where shown or indicated.
   b. Weld-on fittings are acceptable.
   c. Flanged and grooved end joints are not allowed.

2.2 MARKING FOR IDENTIFICATION

A. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify push-on joint and mechanical joint pipe with:
   1. Name or trademark of manufacturer.
   2. Weight, class or nominal thickness, and casting period.
   3. Country where cast.
   4. Year the pipe was produced.
   5. Letters “DI” or “Ductile” shall be cast or metal stamped

B. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify flanged pipe with:
   1. Flange manufacturer’s mark, size, and letters “DI” cast or stamped on the flanges.
   2. Fabricator’s mark if other than flange manufacturer.
   3. Length and weight.

C. In addition to identification markings specified in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation, also stamp, mark, and identify fittings with:
   1. Manufacturer’s identification.
   2. Pressure rating.
   3. Nominal diameters of openings.
   4. Country where cast.
   5. Number of degrees or fraction of the circle on bends.
   6. Letters “DI” or “Ductile” cast on them.

2.3 EXTERIOR SURFACE PREPARATION AND COATINGS

A. General Coating Requirements:
   1. Coating types are specified in piping schedules in Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.

B. Exposed Pipe and Fittings:
   1. Surface Preparation:
      a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
      b. Surface Preparation: Prepare surface in accordance with recommended NAPF 500-03 method.
      c. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
   2. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop.

C. Buried Pipe and Fittings:
   1. Asphaltic Coating: Where specified in piping schedule in Section 33 05 05, Buried Piping Installation, coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect piping to assure that piping is free from defects in material and workmanship. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.2 INSTALLATION AND FIELD QUALITY CONTROL

A. For buried piping installation and testing, refer to Section 33 05 05, Buried Piping Installation.

B. For exposed piping installation and testing, refer to Section 40 05 05, Exposed Piping Installation.

END OF SECTION

SECTION 40 05 31

THERMOPLASTIC PROCESS PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install thermoplastic piping and fittings.
   2. Extent of piping is shown and shall be in accordance with piping schedules in Section 33 05 05, Buried Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items to be installed with or before thermoplastic piping Work.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. AASHTO, Standard Specifications for Highway Bridges.
   2. ASTM D1784, Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   3. ASTM D1785, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   4. ASTM D2464, Specification for Threaded Poly (Vinyl Chlorinated) (PVC) Plastic Pipe Fittings, Schedule 80.
   5. ASTM D2466, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   6. ASTM D2467, Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   7. ASTM D2513, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
   8. ASTM D2564, Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   9. ASTM D2665, Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
   10. ASTM D3034, Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   11. ASTM D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   12. ASTM D3212, Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   13. ASTM D3222, Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
   14. ASTM D3311, Specification for Drain, Waste and Vent (DWV) Plastic Fittings Patterns.
   15. ASTM D4101, Specification for Polypropylene Injection and Extrusion Materials.

16. ASTM F437, Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
17. ASTM F439, Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
18. ASTM F441, Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
19. ASTM F477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
20. ASTM F656, Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
21. ASTM F679, Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
22. ASTM F1336, Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.
23. ASTM F1674, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
24. ASTM F1760, Specification for Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.
25. AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In.-12 In. (100 mm-300 mm), for Water Transmission and Distribution
26. AWWA C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In.-48 In. (350 mm-1,200 mm).
27. AWWA C907, Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm).
28. NSF 14, Plastic Piping Systems Components and Related Material.
29. ANSI/NSF 61, Drinking Water System Components - Health Effects.
30. Standards of U.S. Food and Drug Administration.
31. SCDHEC, State Primary Drinking Water Regulation 61-58.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Shall have a minimum of five years experience producing thermoplastic pipe and fittings substantively similar to the materials specified, and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.
   2. Installer:
      a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
      b. Installer shall have a minimum of five years experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping Work on the Project, and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:
   1. Obtain all materials included in this Section, regardless of component Supplier, from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.
   2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
   3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Submit piping layout Shop Drawings in accordance with Section 33 05 05, Buried Piping Installation.
   2. Product Data:
      a. Submit product data on pipe, fittings, gaskets, hardware, and appurtenances sufficient to demonstrate compliance with the Contract Documents.

B. Informational Submittals: Submit the following:
   1. Certificates:
      a. Submit manufacturer's certificate of compliance standards referenced in this Section.
   2. Source Quality Control Submittals:
      a. When requested by ENGINEER, submit results of source quality control tests.
   3. Qualifications Statements:
      a. Submit qualifications of manufacturer when requested by ENGINEER.
      b. Submit qualifications of installer when requested by ENGINEER.

1.5 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 33 05 05, Buried Piping Installation.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

A. General:
   1. Pipe materials shall be suitable for services intended. Refer to piping schedules in Section 33 05 05, Buried Piping Installation.
   2. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
   3. Comply with NSF 14.
   4. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.
   5. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water, and shall comply with requirements of the authorities having jurisdiction at the Site.

2.2 POLYVINYL CHLORIDE (PVC) PIPING

A. Buried PVC Gravity Sewer Pipe.
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Diamond Plastics Corp.
      c. Or equal.
   2. Material:
      a. Pipe shall comply with ASTM D3034 or ASTM F679 (as applicable).

b. Wall Thickness and Pipe Stiffness: Pipe stiffness shall be determined in accordance with test methods in ASTM D3034 or ASTM F679 (as applicable).
   1) Main Line: SDR 35, with minimum ring stiffness of 46 psi.
   2) Service Laterals: As specified in Section 33 31 01.

3. Fittings:
   a. Injection-molded, gasketed fittings shall comply with ASTM F1336, and ASTM D3034 or ASTM F679 (as applicable).
   b. Fabricated fittings shall comply with ASTM F1336.
   c. Unless otherwise shown or indicated, saddle wyes are unacceptable.
4. Joints:
   a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
   b. Jointing lubricant shall be as recommended by pipe manufacturer.
   c. Provide elastomeric gaskets complying with ASTM F477, and ASTM D3139 or ASTM D3212.

B. Buried PVC Pressure Pipe:
1. Manufacturers: Provide products of one of the following:
   a. Ipex, Inc.
   b. Diamond Plastics Corp.
   c. Or equal.
2. Material:
   a. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
   b. Material shall comply with ASTM D1784.
   c. Wall Thickness:
      1) SDR 14 for 4-inch to 12-inch diameter pipe.
      2) SDR 21 for 14-inch to 48-inch diameter pipe.
   d. Fabricate pipe with cast-iron pipe equivalent outside diameter.
3. Fittings:
   a. Comply with AWWA C900, AWWA C905, or AWWA C907, as applicable.
4. Joints:
   a. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
   b. Jointing lubricant shall be as recommended by pipe manufacturer.
   c. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
   d. Restrained Joints: Provide restrained joints where shown or indicated.
      1) Comply with Section 33 05 05, Buried Piping Installation.
      2) Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:
         a) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
         b) PV-LOK Series, by Sigma Corp.
         c) Or equal.

C. PVC Drain, Waste, and Vent (PVC-DWV) Pipe.
1. Manufacturers: Provide products of one of the following:
   a. Chemtrol, manufactured by Nibco, Inc.
   b. Spears Manufacturing Company.

c. Or equal.
2. Material: In accordance with ASTM D1784. Unless otherwise shown or indicated, PVC-DWV pipe shall be:
   a. Type and Grade: Type 1, Grade 1.
   b. Wall Thickness: Schedule 40.
   c. Color: White.
3. Fittings: Manufactured in accordance with ASTM D2665 and ASTM D3311.
   a. Solvent weld.
   b. Spigot.
4. Joints:
   a. Solvent weld.
   b. Threaded.

2.3 CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPING

A. CPVC Pipe – General Applications: Unless otherwise shown or indicated, CPVC pipe shall comply with the following:
   1. Manufacturers: Provide products of one of the following:
      a. Ipex, Inc.
      b. Spears Manufacturing Company.
      c. Or equal.
   2. Material: Comply with ASTM F441/F441M as having same outside diameter as iron pipe. Comply with the following:
      a. Type and Grade: Type IV, Grade 1.
      b. Wall Thickness: Schedule 80.
      c. Temperature Rating: Rated to 210 degrees F.
      d. Color: Gray.
      e. Manufacture pipe and fittings with minimum of two percent of titanium oxide for ultraviolet protection.
   3. Fittings: Type, grade, schedule, and color of fittings shall match the associated pipe.
      a. Solvent Welded: Fittings shall comply with F439 for socket type.
      b. Threaded: Shall comply with ASTM F437.
   4. Joints:
      a. Solvent Welded: Use primer and solvent cement recommended by CPVC pipe manufacturer. Primer shall be in accordance with ASTM F656, and solvent cement shall be in accordance with ASTM D2564.
      b. Threaded: Use 100 percent virgin polytetrafluoroethylene (Teflon or PTFE) tape for threaded fittings. Pipe shall not be threaded.

2.4 IDENTIFICATION

A. Pipe material identification requirements are in Section 33 05 05, Buried Piping Installation.

2.5 SOURCE QUALITY CONTROL

A. Shop Tests:
   1. Pipe manufacturer shall maintain continuous quality control program.
   2. Where applicable and when requested by ENGINEER, submit results of source quality control tests specified in reference standards.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect pipe materials for defects in material and workmanship. Verify compatibility of pipe and fittings.

3.2 INSTALLATION

A. For buried piping installation, refer to Section 33 05 05, Buried Piping Installation.

END OF SECTION

SECTION 40 05 53

PROCESS VALVES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install process valves and appurtenances, complete and operational.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate installation of items that must be installed with or before process valves Work.

C. Related Sections:
   1. Section 33 05 05, Buried Piping Installation.
   2. Section 40 05 05, Exposed Piping Installation.

1.2 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Bearing Manufacturers Association (ABMA).
   2. ANSI B16.1, Cast-Iron Pipe Flanges and Flanged Fittings.
   3. ANSI B16.34, Valves-Flanged, Threaded and Welding end. (ASME B16.34).
   4. ANSI/NSF 61 Drinking Water Components – Health Effects.
   5. API STD 594, Check Valves, Flanged Lug, Wafer and Butt-Welding.
   6. API STD 598, Valve Inspection and Testing.
   7. API STD 609, Butterfly Valves: Double Flanged, Lug-Type and Wafer-Type.
   8. ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
   9. ASTM A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   10. ASTM A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.
   11. ASTM A240/A240M, Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   12. ASTM A276, Specification for Stainless Steel Bars and Shapes.
   13. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   14. ASTM A351/A351M, Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
   15. ASTM A380, Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.
   16. ASTM A536, Specification for Ductile Iron Castings.
   17. ASTM A564/A564M, Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.

18. ASTM A743/A743 M, Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
19. ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
20. ASTM B98/B98M, Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
21. ASTM B138/B138M, Specification for Manganese Bronze Rod, Bar and Shapes.
22. ASTM B265, Specification for Titanium and Titanium Alloy Strip, Sheet and Plate.
23. ASTM B584, Specification for Copper Alloy Sand Castings for General Applications.
24. ASTM D429, Test Methods for Rubber Property - Adhesion to Rigid Substrates.
25. AWWA C502, Dry-Barrel Fire Hydrants.
26. AWWA C504, Rubber-Seated Butterfly Valves.
27. AWWA C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch NPS.
28. AWWA C509, Resilient-Seated Gate Valves for Water Supply Service.
29. AWWA C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
30. AWWA C550, Protective Interior Coatings for Valves and Hydrants.
31. AWWA Manual M49, Butterfly Valves: Torque, Head Loss, and Cavitation Analysis.
32. FS TT-C-494, Coating Compound, Bituminous, Solvent Type, Acid-Resistant.
33. NEMA MG 1, Motors and Generators.
34. MSS SP-60, Connecting Flange Joints Between Tapping Sleeves and Tapping Valves.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall have minimum of five years of experience producing substantially similar materials and equipment to that required and be able to provide evidence of at least five installations in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Obtain each type of equipment and appurtenances included in this Section, regardless of the component manufacturer, from a single manufacturer of the type of process valve. For each type of valve, do not furnish valves of more than one manufacturer.
   2. Supplier of each type of equipment specified shall review and approve or prepare all Shop Drawings and other submittals for all components associated with the type of process valve Supplier is furnishing.
   3. Components shall be suitable for use in the specified service conditions. Components shall be integrated into the overall assembly by the process valve manufacturer.

1.4 SUBMITTALS

A. Action Submittals: Submit the following:
   1. Shop Drawings:
      a. Installation drawings showing orientation of valve in both plan and elevation view. Drawings shall clearly identify valve and its appurtenances, including controls, actuators, valve stems, and other components. Show dimensions of valves and appurtenances in relation to piping and structural and architectural components, where applicable.
      b. Controls for and control characteristics of modulating valves.
      c. Calculations for sizing of operating mechanism with extension stems.
      d. Calculations for sizing of gear actuators.
   2. Product Data:

a. Product data sheets.
b. Complete catalog information, including dimensions, weight, specifications, and identification of materials of construction of all parts.
c. Corrosion resistance information to confirm suitability of valve materials for the application. Furnish information on chemical resistance of elastomers from elastomer manufacturer.
d. Cv values and hydraulic headloss curves.

3. Testing Plans:
   a. Submit plan for shop testing of each valve for which shop testing is specified, including testing plan's and test facility's limitations proposed.

B. Informational Submittals: Submit the following:
1. Certificates:
   a. Certificates of compliance with referenced standards, where applicable, including those of AWWA, NSF, and others required by ENGINEER.
2. Manufacturer Instructions:
   a. Submit manufacturer's instructions for handling, storing, and installing valves and appurtenances. Provide templates and setting drawings for valves and appurtenances that require anchor bolts or similar anchorages.
3. Source Quality Control Submittals:
   a. Submit copies of shop test results and inspection data, certified by manufacturer.
4. Field Quality Control Submittals:
   a. Submit results of field tests required.
5. Supplier's Reports:
   a. When requested by ENGINEER, submit written report of results of each visit to Site by Supplier's serviceman, including purpose and time of visit, tasks performed and results obtained.
6. Qualifications Statements:
   a. When requested by ENGINEER, submit manufacturer's qualifications demonstrating compliance with the Specifications, including list of existing installations with contact names and telephone number(s) for each.

C. Closeout Submittals: Submit the following:
1. Operations and Maintenance Data:
   a. Furnish operation and maintenance manuals in accordance with Section 01 78 23, Operations and Maintenance Data.
   b. Furnish in operations and maintenance manuals complete nameplate data for each valve.

D. Maintenance Material Submittals: Submit the following:
1. Spare Parts, Extra Stock Materials, and Tools:
   a. Spare Parts and Extra Stock Materials: Furnish as specified for each valve type.

1.5 DELIVERY, STORAGE AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
1. Deliver materials and equipment to Site to ensure uninterrupted progress of the Work. Deliver anchorage products that are to be embedded in concrete in ample time to prevent delaying the Work.

2. Inspect boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to materials and equipment. Promptly remedy loss and damage to new condition in accordance with manufacturer's instructions.
3. Conform to Section 01 65 00, Product Delivery Requirements.

B. Storage and Protection:
1. Keep products off ground using pallets, platforms, or other supports. Store equipment in covered storage and prevent condensation and damage by extreme temperatures. Store in accordance with manufacturer's recommendations. Protect steel, packaged materials, and electronics from corrosion and deterioration.
2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

PART 2 PRODUCTS

2.1 GENERAL

A. Valves, General:
1. Provide each valve with manufacturer's name and rated pressure cast in raised letters on valve body.
2. Provide valves with brass or Type 316 stainless steel nameplate attached with Type 316 stainless steel screws. Nameplates shall have engraved letters displaying the following minimum information:
a. Valve size.
b. Pressure and temperature ratings.
c. Application (other than water and wastewater).
d. Date of manufacture.
e. Manufacturer's name.
3. Provide hydrants, gate valves larger than 6-inches and butterfly valves to turn counter-clockwise to open, unless otherwise specified. Provide gate valves smaller than 3-inches to turn clockwise to open.
4. Provide valves with permanent markings for direction to open.
5. Manually operated valves, with or without extension stems, shall require not more than 40-pound pull on manual operator to open or close valve against specified criteria. Gear actuator and valve components shall be able to withstand minimum pull of 200 pounds on manual operator and input torque of 300-foot pounds to actuator nut. Manual operators include handwheel, chainwheel, crank, lever, and T-handle wrench.

B. Valve Materials:
1. Valve materials shall be suitable for the associated valve's service or application, as shown.
2. Protect wetted parts from galvanic corrosion caused by contact of different metals.
3. Wetted components and wetted surfaces of valves used with potable water or water that will be treated to become potable shall conform to ANSI/NSF 61.
4. Clean and descale fabricated stainless steel items in accordance with ASTM A380 and the following:
a. Passivate all stainless steel welded fabricated items after manufacture by immersing in pickling solution of six percent nitric acid and three percent hydrofluoric acid. Temperature and detention time shall be sufficient for removing

oxidation and ferrous contamination without etching surface. Perform complete neutralizing operation by immersing in trisodium phosphate rinse followed by clean water wash.

b. Scrub welds with same pickling solution or pickling paste and clean with stainless steel wire brushes or by grinding with non-metallic abrasive tools to remove weld discoloration, and then neutralize and wash clean.

C. Valve Joints:
1. Exposed Valves: Unless otherwise specified, provide with flanged ends conforming to ANSI B16.1. Pressure class of flanges shall be equal to or greater than specified pressure rating of the associated valve.
2. Buried Valves: Unless otherwise specified, provide with mechanical joints, restrained or unrestrained, as required by piping with which valve is installed.
3. For stainless steel bolting, except where nitrided nuts are required, use graphite-free anti-seize compound to prevent galling. Strength of joint shall not be affected by using anti-seize compound.

2.2 RESILIENT-SEATED GATE VALVES

A. Manufacturers: Provide products of one of the following:
1. American Cast Iron Pipe Company, Series 2500 RW.
2. Clow Valve Co., Model 2638, Model 2639 or Model 2640.
3. Kennedy Valve Co., Model KS-FW or Model KS-RW.
4. M&H Valve Co., Style 4067 or Style 7000.
5. Mueller Co., 2361 Series or 2362 Series.
6. Or equal.

B. General:
1. Provide valves conforming to AWWA C509 or C515 and as specified in this Section.
2. Type:
a. Provide non-rising stem (NRS) valves for buried service.
b. Provide NRS valves for exposed service unless specified otherwise.
c. Provide position indicators for NRS valves used in exposed service.
3. Stem seals shall be of the “O” ring type, only.
4. Minimum Rated Working Pressure: 200 psig.
5. Maximum Fluid Temperature: 150 degrees F.
6. Provide valves with fully encapsulated resilient wedges, unless otherwise specified.
7. Gate valves on water mains shall be direct bury gate valves and shall be furnished with standard valves boxes set in concrete pads as specified in Section 03 00 05, Concrete.
8. Valve ends for buried valves shall be mechanical joint with necessary glands, gaskets and bolts furnished with the valve.
9. Valve ends for exposed valves shall be flange joint.

C. Materials of Construction: Shall conform to AWWA C509 or AWWA C515 and shall be as follows:
1. Valve Body, Bonnet, and Stuffing Box: Cast-iron.
2. Wedge: Cast-iron, symmetrically and fully encapsulated with molded rubber having minimum 1/8-inch thickness.
3. Stem: Manganese bronze.
4. Rubber Items: Buna-N or other synthetic rubber suitable for the application.

5. Internal and external bolting and other hardware including pins, set screws, plug, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
6. Valves 3-inch and smaller may be of all bronze construction with iron pipe thread and screw ends and comply with AWWA C509 or C515 and ASTM B62.

D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

E. Testing:
1. Test valves in valve manufacturer's shop in accordance with AWWA C509 or AWWA C515.

F. Gear Actuators for Manually-operated Valves:
1. Provide valves with gear actuators conforming to AWWA C509 or AWWA C515.
2. Size gear actuators for maximum differential pressures of service requirements.
3. Valves 6-inches and larger shall be furnished with 2-inch square operating nuts.
4. Valves 3-inch and smaller shall be furnished with T-Head operating nuts, unless a hand wheel is specified.

2.3 BUTTERFLY VALVES

A. Manufacturers: Provide products of one of the following:
1. American Cast Iron Pipe Co.
2. Clow Valve Co.
3. Kennedy Valve Co.
4. Mueller Co.
5. Henry Pratt Co.
6. Or equal.

B. General:
1. Provide butterfly valves conforming to AWWA C504 and as specified herein.
2. Rated Working Pressure: 150 psig, Class 150B.
3. Maximum Fluid Temperature: 150 degrees F.
4. Valves shall provide drip-tight bi-directional shutoff at rated pressures.
5. Mount valve seats in valve body. Rubber seats for 24-inch diameter and larger valves shall be replaceable in the field.
6. Valves shall be capable of being maintained in open or partially open position for manual operation, and for automatic operation. When valve disc is maintained, there shall be no chatter or vibration of disc or operating mechanism.
7. Valve packing shall be replaceable without dismantling valve.
8. Disc shall be offset from shaft to provide uninterrupted 360-degree seat seal.

C. Materials of Construction: materials of construction shall conform to AWWA C504 and shall be as follows:
1. Body: Cast-iron, ductile iron, or alloy cast-iron.
2. Shaft: Type 316 stainless steel.
3. Discs:
   a. Valves Smaller than 30-inch Diameter: Cast-iron.
   b. Valves 30-inch Diameter and Larger: Ductile iron.

4. Seats: Buna-N or other synthetic rubber suitable for the application.
5. Seating Surfaces: Type 316 stainless steel.
6. Bearings:
   a. Valves Smaller than 24-inch Diameter: Nylon.
   b. Valves 24-inch Diameter and Larger: Fiberglass with Teflon lining.
7. Shaft Seals: Externally adjustable, material same as for seats. For services that are either buried or submerged, self-adjusting V-type chevron, material same as for seats.
8. Tapered Pins for Attachment of Shaft to Disc: Type 316 stainless steel.
9. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.

D. Interior Coating:
1. Valves shall be coated inside. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy-coated in accordance with AWWA C550.

E. Testing:
1. Test each valve in the manufacturer's shop in accordance with AWWA C504.

F. Gear Actuators for Manual Valves:
1. Provide gear actuators conforming to AWWA C540.
2. Gear actuators for valves 20-inch diameter and smaller shall be constructed for 150 psi differential pressure and 16 feet per second port velocity.
3. Gear actuators for valves 24-inch diameter and larger shall be constructed for maximum differential pressures and velocities as scheduled.
4. Butterfly valves shall be furnished with a manual operator equipped with a 2-inch square operating nut. The valve and operator shall be assembled for installation in a horizontal line with the main valve shaft horizontal and the operator shaft and operating nut aligned vertically to accept a valve key operated form the surface.

2.4 DETECTOR CHECK VALVES

A. Manufacturers: Provide products of one of the following:
1. Ames Co., Model 3000SS.
2. Febco, Model 800.
3. Watts, 007 Series.
4. Or equal.

B. General:
1. Provide valves conforming to AWWA C508 and as specified herein.
2. Type: Resilient-seated.
3. Rated Working Pressure: 175 psig.
4. Provide valves suitable for horizontal or vertical mounting.
5. Check valves shall have clear waterway with full-open area equal to nominal pipe size.
6. Provide check valves with outside adjustable weight and lever.
7. Provide valves larger than six-inch diameter with adjustable air cushion chambers.
8. Valve seats shall be mechanically attached and shall be field replaceable.
9. Four-inch through ten-inch detector check valves shall have flanged ends per ANSI B16.1, Class 125.
10. Valves shall be furnished with two tapped bosses on each side to permit installation of a metered bypass.

C. Materials of Construction: All materials of construction shall conform to AWWA C508 and shall be as follows:
   1. Body, Disc, Cover and Gland: Cast-iron or ductile iron.
   2. Disc Arm: Ductile iron.
   3. Hinge Shaft: Type 316 stainless steel or bronze.
   4. Hinge Shaft Bushings: Bronze, or Type 316 stainless steel for sewage service.
   5. Shaft End Plate: Type 316 stainless steel or bronze.
   6. Body Seat: Bronze.
   7. Follower Ring for Rubber Seat on Disc: Type 316 stainless steel or bronze.
   8. Disc Center Pin Assembly: Type 316 stainless steel or bronze.
   9. Air Cushion Chamber:
      a. Chamber and Plunger: Bronze.
      b. Linkages and Pins: Type 316 stainless steel or bronze.
      c. Air Check Valve and Tubing: Brass or stainless steel.
   10. Rubber Items:
      a. Applications Up to 180-degree F Fluid Temperature: Buna-N or other synthetic rubber suitable for the application.
      b. Applications 180-degrees F and Greater Fluid Temperature: Viton, or other synthetic rubber suitable for the application.
   11. Internal and external bolting and other hardware; including pins, set screws, studs, bolts, nuts, and washers shall be Type 316 stainless steel.
   12. Gland Packing: Graphite and Kevlar.

D. Interior Coating:
   1. Valves shall be coated inside. Cast-iron and ductile iron surfaces, except machined surfaces, shall be fusion-bonded epoxy coated in accordance with AWWA C550. Steel surfaces shall be hot-dip zinc galvanized or fusion-bonded epoxy coated.

E. Testing:
   1. Test each valve in manufacturer's shop in accordance with AWWA C508.
   2. Allowable Leakage at Rated Pressures: Zero.

2.5 FIRE HYDRANTS

A. Products and Manufacturers: Provide one of the following:
   1. Mueller, Model: Super Centurion 250 A-421.
   2. Or equal.

B. General:
   1. Provide fire hydrants conforming to AWWA C502, Underwriters' Laboratories-listed and Factory Mutual approved, and as specified herein.
   2. Rated Working Pressure: 175 psig, minimum.
   3. Rated Hydrostatic Test Pressure: 400 psig, minimum.
   4. Depth of Cover: Minimum 3-feet.
   5. Inlet: 6-inch mechanical joint.

C. Construction:
   1. Type: Three-way fire hydrants with two hose nozzles and one pumper nozzle.
   2. Nozzles:

a. Provide one minimum 5-inch Storz pumper nozzle and two 2.5-inch diameter hose nozzles with NFPA threads.
b. Nozzles shall be O-ring sealed, threaded, and retained with stainless steel locks. Nozzles shall be field replaceable.

3. Main Valve and Drainage Assembly:
   a. Opening: 4.5-inch minimum diameter.
   b. Main valve shall be compression type provided with upper and lower metal plates and lower valve plate nut.
   c. Barrel drainage shall be through dual drain valves. Opening and closing of main valve shall cause force-flush of dual drain ports.
   d. Main valve seat ring shall be easily replaceable from above-ground.
4. Provide an oil filled reservoir for lubrication of stem threads and bearing surfaces. Oil shall be U.S. Food and Drug Administration approved and ANSI/NSF 61-listed, and shall flow freely in temperature range of -60 to 158 degrees F.
5. Provide traffic flange in barrel and safety coupling in stem.
6. Inlet Connection: Six-inch diameter mechanical joint, restrained.
7. Operating Nut: 1.25-inch and pentagon-shaped.

D. Materials of Construction: Materials of construction shall conform to the requirements of AWWA C502 and shall be as follows:
   1. Upper and Lower Barrels, Shoe, and Bonnet: Cast-iron.
   2. Stem and Accessories:
      a. Upper and Lower Stems: Steel.
      b. Operating Nut: Bronze.
      c. Safety Coupling: Stainless steel.
   3. Nozzles:
      a. Pumper and Hose Nozzles: Bronze.
      b. Nozzle Caps: Cast-iron.
      c. Cap Chains: Steel.
   4. Main Valve Assembly:
      a. Main Valve: Rubber.
      b. Upper Valve Plate: Bronze.
      c. Lower Valve Plate and Nut: Cast-iron.
      d. Seat and receiving connection at base of hydrant: Bronze.
   5. Drain Valves:
      a. Drain Ring Housing: Cast-iron.
      b. Drain Ring: Bronze.
   6. O-ring Gaskets: Rubber.
   7. External Assembly Bolts: Steel.
   8. Internal Pins and Other Hardware: Stainless steel, ASTM A276.

E. Testing:
   1. Test each fire hydrant in manufacturer's shop in conformance with AWWA C502.

F. Interior Coating:
   1. Hydrants shall be coated on the interior. Steel, cast-iron, and ductile iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

G. Exterior Painting:

1. All hydrants and any portion of hydrant assembly exposed to view shall be painted with minimum 2 even coats of white hydrant enamel paint.
2. Below- and above-ground painting shall be as specified under Article 2.11 of this Section and Article 2.12 of this Section.

H. Appurtenances for Hydrants:
1. Fire hydrant tees shall be Griffin Swivel hydrant Tee, Tyler 5-125 swivel hydrant tee or approved equal.
2. Piping extension for hydrant installations may be made with 6-inch ductile iron nipples with Tyler long swivel hydrant adapters, Megalug MJ Restraint, U.S. Pipe Field Lok Gaskets, Romac Grip Ring, or other approved method.

2.6 APPURTENANCES FOR EXPOSED METALLIC VALVES

A. General:
1. For valves located less than five feet above operating floor, provide levers on four-inch diameter quarter-turn valves, and provide handwheels on all other valves, unless otherwise shown or specified.
2. For valves located five feet or more above operating floor, provide chain operators.
3. Where indicated, provide extension stems and floorstands.

B. Handwheels:
1. Conform to applicable AWWA standards.
2. Material of Construction: Ductile iron or cast aluminum.
3. Arrow indicating direction of opening and word “OPEN” shall be cast on trim of handwheel.
4. Maximum Handwheel Diameter: 2.5 feet.

C. Crank Operator:
1. Crank operator shall be removable and fitted with rotating handle.
2. Maximum Radius of Crank: 15 inches.
3. Materials:
   a. Crank: Cast-iron or ductile iron.
   b. Handle: Type 304 stainless steel.
   c. Hardware: Type 304 stainless steel.

D. Extension Stems and Floor Stands for Gate Valves:
1. Conform to the applicable requirements of AWWA C501 for sizing of complete lifting mechanism.
2. Bench and Pedestal Floor Stands:
   a. For valves requiring extension stems, provide bench or pedestal floor stands with handwheel or crank as indicated. Provide provisions for using portable electric actuator for opening and closing of valves.
   b. Type: Heavy-duty with tapered roller bearings enclosed in a weatherproof housing, provided with positive mechanical seals around lift nut and pinion shaft to prevent loss of lubrication and to prevent moisture from entering housing. Provide lubrication fitting for grease. For valves conveying water that is potable or that will be treated to become potable, grease shall be food-grade and ANSI/NSF 61-listed. Base shall be machined.
   c. Materials of Construction:

1) Housing: Cast-iron, ASTM A126, Class B.
2) Lift Nut: Cast bronze, ASTM B98/B98M.
3) Grease Fitting: Stainless steel.
4) Bolting: Type 316 stainless steel.

3. Wall brackets for floor stands shall be Type 316L stainless steel construction.
4. Extension Stems:
   a. Materials of Stems and Stem Couplings: Type 316 stainless steel.
   b. Maximum Slenderness Ratio (L/R): 100.
   c. Minimum Diameter: 1.5-inch.
   d. Threads: Acme.
   e. Provide stem couplings where stems are furnished in more than one piece. Couplings shall be threaded and keyed or threaded and bolted and shall be of greater strength than the stem.
   f. Weld to bottom of extension stem a Type 316 stainless steel cap suitable for square end of valve stem.
5. Bottom Couplings: Ductile iron with Type 316 stainless steel pin and set screw.
6. Stem Guides:
   a. Material: Type 316 cast stainless steel with bronze bushing for stem. For submerged service, Type 316 cast stainless steel with stainless steel bushing for stem.
   b. Maximum Stem Length Between Guides: Seven feet.
   c. Stem guides shall be adjustable in two directions.
7. Furnish stem cover of clear butyrate plastic or Grade 153 Lexan with cast adapter for mounting cover to bench and floor stands. Provide stem cover with gasketing and breathers to eliminate water intrusion into operator and condensation within cover. Provide stem cover with mylar tape with legible markings showing valve position at one-inch intervals and open and close limits of valve.

E. Floor Boxes: Provide cast-iron floor boxes for valves that are to be operated from floor above valve. Boxes shall be equal in depth to floor slab. Boxes shall have cast-iron covers and be fitted with bronze bushing.

2.7 APPURTENANCES FOR BURIED METALLIC VALVES

A. Wrench Nuts:
   1. Provide wrench nuts on buried valves of nominal two-inch size, in accordance with AWWA C509.
   2. Arrow indicating direction of opening the valve shall be cast on the nut along with the word “OPEN”.
   3. Material: Cast-iron.
   4. Secure nut to stem by mechanical means.

B. Extension Stems for Non-Rising Stem Gate Valves and Quarter-turn Buried Valves:
   1. Provide extension stems to bring operating nut to six inches below valve box cover.
   2. Materials of Stems and Stem Couplings: Type 316 stainless steel.
   3. Maximum Slenderness Ratio (L/R): 100
   4. Provide top nut and bottom coupling of ductile iron or cast-iron with pins and set screws of Type 316 stainless steel.

C. Valve Boxes:

1. Valve boxes shall be as indicated and as required.
2. Type: Heavy-duty, suitable for highway loading, two-piece telescopic, and adjustable. Lower section shall enclose valve operating nut and stuffing box and rest on valve bonnet.
3. Material: Cast-iron.
4. Coating: Two coats of asphalt varnish conforming to FS TT-C-494.
5. Marking: As required for service.

2.8 TAPPING SLEEVES

A. Products and Manufacturers: Provide one of the following:
   a. Ford Fast.
   b. Romac STS420.
   c. Smith-Blair Model 663.
   d. JCM Industries Model 432.
   e. PowerSeal 3480AS.
   f. PowerSeal 3490AS.
   g. Or approved equal.

B. General:
   1. Application: Potable water service distribution water line.
   2. Tapping sleeves shall be stainless steel or epoxy-coated steel full gasket with wedge gaskets around tap openings.
   3. Stainless steel sleeves shall be 18/8, Type 304 stainless steel.
   4. Tapping sleeves shall include test plugs.
   5. Tapping sleeves 12-inch and smaller shall meet minimum working pressure requirement of 200 psi.
   6. Tapping sleeves 14-inch and larger shall meet minimum working pressure requirement of 150 psi.

C. Construction:
   1. Sleeve outlet flange shall be stainless steel and be Class D per AWWA C207 ANSI 150 pound drilling compatible with approved tapping valves.
   2. Flanged end shall feature lip in accordance with MSS SP-60.
   3. Sleeve gasket shall be of a grid pattern design and shall provide full circumferential sealing around the tapped pipe.
   4. All welds of tapping sleeve shall be passivated.
   5. Tapping valves shall conform to the specifications and approved brands as outlined in this Section.
   6. Tapping valves shall have oversized seat rings and feature one flanged end and one standard mechanical joint.

2.9 ANCHORAGES AND MOUNTING HARDWARE

A. General:
   1. Bolts, nuts, and washers shall be of ample size and strength for purpose intended. Anchorages in concrete shall be at least 5/8-inch diameter.
   2. Provide stem guide anchorages of required strength to prevent twisting and sagging of guides under load.

3. Materials: Provide bolts and washers of Type 316 stainless steel and nitrided nuts. Bolts shall have rolled threads. Bolts and nuts shall be electropolished to remove burrs.

2.10 TOOLS, LUBRICANTS, AND SPARE PARTS

A. Provide T-handle operating wrenches for buried valves as required by the County.

B. Lubricants: For valves, actuators, and appurtenances requiring lubricants, provide suitable lubricants for initial operation and for first year of use following Substantial Completion. Lubricants for equipment associated with conveying potable water or water that will be treated to become potable shall be food-grade and ANSI/NSF 61-listed.

C. Provide tools, spare parts, and maintenance materials.

2.11 PAINTING OF EXPOSED VALVES, HYDRANTS, AND APPURTENANCES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined surfaces of exposed valves and appurtenances, shall be finish painted in manufacturer's shop. Surface preparation, priming, finish painting, and field touch-up painting shall conform to the manufacturer's paint standards.

2.12 PAINTING OF BURIED VALVES

A. Exterior steel, cast-iron, and ductile iron surfaces, except machined or bearing surfaces of buried valves, shall be painted in valve manufacturer's shop with two coats of asphalt varnish conforming to FS TT-C 494.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which materials and equipment are to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Install valves and appurtenances in accordance with:
      a. Supplier's instructions and the Contract Documents.
      b. Requirements of applicable AWWA standards.
      c. Applicable requirements of Section 33 05 05, Buried Piping Installation, and Section 40 05 05, Exposed Piping Installation.
   2. Install valves plumb and level. Install all valves to be free from distortion and strain caused by misaligned piping, equipment, and other causes.

3. Position detector check valves and butterfly valves so that, when valve is fully open, valve disc does not conflict with piping system elements upstream and downstream of valve.

B. Exposed Valves:
   1. Provide supports for large or heavy valves and appurtenances as shown or required to prevent strain on adjoining piping.
   2. Operators:
      a. Install valves so that operating handwheels or levers can be conveniently turned from operating floor without interfering with access to other valves, piping, structure, and equipment, and as approved by ENGINEER.
      b. Avoid placing operators at angles to floors or walls.
      c. Orient chain operators out of way of walking areas.
      d. Install valves so that indicator arrows are visible from floor level.
      e. For motor-operated valves located lower than five feet above operating floor, orient motor actuator to allow convenient access to pushbuttons and handwheel.
   3. Floor Stands and Stems:
      a. Install floor stands as shown and as recommended by manufacturer.
      b. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by manufacturer.
      c. Provide sleeves where operating stems pass through floor. Extend sleeves two inches above floor.

C. Buried Valves:
   1. Install valve boxes plumb and centered, with soil carefully tamped to a lateral distance of four feet on all sides of box, or to undisturbed trench face if less than four feet.

D. Hydrants:
   1. Hydrant drains shall not be connected to, or located within 10 feet of, sanitary sewer systems.
   2. Install tracer wire per fire hydrant detail.

E. Tapping Sleeves:
   1. Place the lower half of the tapping sleeve under the pipe to be tapped. Support sleeve with blocks and place the gaskets. Place the upper half of the sleeve over the pipe, insert the bolts, rotate the sleeve to proper position and tighten the nuts evenly. Bolt tapping valve to the sleeve outlet, attach tapping machine to the valve, drill and tap central hole and cut outlet in main. After opening has been made, withdraw the drill, cut-out portion of pipe wall and the cutter and close tapping valve. Remove and temporary extension piping used to make connection.
   2. Coat threads on tapping sleeve bolts with anti-gall coating prior to installation.
   3. Leave newly-installed tapping sleeve and valve exposed for a minimum period of 24 hours to permit inspection of the joints and valve for leaks. Test at same hydrostatic pressure as that present in existing main.
   4. Correct all visible leaks, if any, at no additional cost to Owner. After such leaks have been sealed, again leave sleeve and valve exposed for a minimum period of 24 hours. Repeat this procedure until Engineer accepts installation and then commence backfilling.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Adjust all parts and components as required to provide correct operation of valves.
   2. Conduct functional field test on each valve in presence of ENGINEER to demonstrate that each valve operates correctly.
   3. Verify satisfactory operation and controls of motor operated valves.
   4. Demonstrate satisfactory opening and closing of valves at specified criteria requiring not more than 40 pounds effort on manual actuators.
   5. Test ten percent of valves of each type by applying 200 pounds effort on manual operators. There shall be no damage to gear actuator or valve.

B. Tests for Tapping Sleeves
   1. Perform hydrostatic and leakage tests on tapping sleeves in accordance with AWWA C600.
   2. All leaks and any defective material shall be repaired or replaced to the satisfaction of the Engineer and the tests repeated until the requirements of this specification are met.
   3. Furnish any special equipment required to conduct the test.
   4. If hydrants or other openings are not available for the purpose of expelling air, provide air releases of sufficient size (as determined by the Engineer) in accordance with the Drawings at the Contractor's expense.
   5. Test pressure shall be held for at least 2 hours at minimum 150% the maximum working pressure at the low point of the section being tested. If testing against butterfly valves, the differential pressure must not exceed 150 psi for valves rated at 150 psi.
   6. If the test cannot be executed with differential pressure of 150 psi, a 250 psi valve shall be specified.
   7. Differential test pressures against gate valves shall not exceed 200 psi.
   8. Allowable leakage shall be determined by AWWA C600.

END OF SECTION

SECTION 40 05 86

AIR VALVES FOR WATER AND WASTEWATER SERVICE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish, install, and test Air Valves for water and wastewater service complete with appurtenances.
   2. This Section does not include:
      a. Valves specified in other Sections
      b. Valves furnished with equipment
      c. Non-metallic valves.

B. Coordination:
   1. Review installation procedures for this and other Specification sections and coordinate Work that must be installed with or before Work under this Section.
   2. If this is a multiple-prime contract project, provide timely advance notification of schedule of work to other contractors who may need to install items at same time or before Work included in this Section.

C. Related Sections:
   1. Section 40 05 53, Process Valves

1.2 REFERENCES

A. Standards referenced in this Section are:
   1. ANSI/AWWA C512, Air Release, Air Vacuum and Combination Air Valves for Waterworks Service
   2. ANSI/AWWA C550, Protective Interior Coatings for Valves and Hydrants.
   3. ANSI/NSF 61 Drinking Water Components – Health Effects

1.3 DEFINITIONS

A. The following definitions apply to this Section.
   1. Air Release Valve: A hydromechanical device designed to automatically release to atmosphere small pockets of air as they accumulate in a pipeline when pipeline system is full and operating under pressure.
   2. Air/Vacuum Valve: Direct-acting, float-operated, hydromechanical device designed to automatically release or admit large volumes of air during filling or draining of a pipeline or piping system. Valve will open to relieve negative pressures and will not reopen to vent air when system is full and under pressure.
   3. Air Valve: Valve of one of the following types: Air Release Valve, Air/Vacuum Valve, or Combination Air Valve.
   4. Maximum and Minimum Working Pressure: Pressure range at which valve is designed to function.

5. Orifice: Opening in valve mechanism through which air is expelled from or admitted into pipeline or piping system.
6. Valve Design Pressure: Maximum pressure to which a valve may be subjected without exceeding allowable stress of its components.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. Manufacturer shall be able to provide documentation of at least five installations of substantially similar equipment to that specified, in satisfactory operation for at least five years.

B. Component Supply and Compatibility:
   1. Valves of the same type, including specified accessories, shall be products of or furnished by a single air valve manufacturer.

C. Regulatory Requirements.
   1. Drinking Water Requirements: Valves that will be in contact with potable water or water that will be treated to become potable shall comply with ANSI/NSF 61 and the Safe Drinking Water Act.

1.5 SUBMITTALS

A. Action Submittals.
   1. Product Data: Submit the following for each type and size of valve specified:
      a. Product data sheet.
      b. Complete catalog information, including dimensions, weight, performance data, Orifice size, specifications, and identification of materials of each part.

B. Informational Submittals:
   1. Certifications:
      a. Submit a certificate signed by manufacturer of each product stating that product conforms to applicable referenced standards and specified requirements.
   2. Test Reports:
      a. Provide results of successful factory tests prior to shipping products to the Site.
   3. Manufacturer's Reports:
      a. Submit written report of results of each visit to Site by a manufacturer's serviceman, including purpose and time of visit, tasks performed, and results obtained.

C. Closeout Submittals.
   1. Operation and Maintenance Data:
      a. Submit complete operation and maintenance manual for all Air Valves in the Contract, including maintenance data and schedules in sufficient detail for disassembly and assembly of valve, and identifying parts that can be replaced.
      b. Furnish operation and maintenance manuals per Section 01 78 23, Operations and Maintenance Data.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading:
   1. Prepare valves for shipping per Section 6.2 of ANSI/AWWA C512.
   2. Conform to Section 01 65 00, Product Delivery Requirements.

B. Acceptance at Site:
   1. Inspect all boxes, crates, and packages upon delivery to Site and notify ENGINEER in writing of loss or damage to products. Promptly remedy loss and damage to new condition per manufacturer's instructions.

C. Storage and Protection:
   1. Keep all products off ground using pallets, platforms, or other supports. Protect products from corrosion and deterioration.
   2. Conform to Section 01 66 00, Product Storage and Handling Requirements.

1.7 MAINTENANCE

A. Extra Materials (for capital projects):
   1. Furnish complete valves or sets of field replaceable parts for each type and size of valve installed, tagged and boxed for long-term storage as follows:

Quantity of Valves Installed	**Spare Valves (1) or Sets of Spare Parts (2)**
1 to 5	1
6 to 10	2
11 to 15	3
16 or more	5

Notes:
(1) For valves smaller than 4-inch diameter furnish complete valve instead of sets of spare parts. Complete valve does not include accessories that are not typically furnished with valve model.
(2) Set of field-replaceable spare parts includes one gasket and all field-replaceable seats and bushings.

PART 2 PRODUCTS

2.1 GENERAL

A. Extent:
   1. Provide valves included in this Section and as shown on the Drawings.

B. Requirements:
   1. Size: Air valve shall be sized per manufacturer's recommendations.
   2. Valve Design Pressure: Unless otherwise specified, Valve Design Pressure shall be equal to or exceed design pressure of pipe or equipment on which the valve is installed.
   3. Valve Type, Service, Inlet Size, Orifice Size, Accessories, and Required Features: Provide per the Drawings.

4. Materials: Air Valve materials shall be suitable for long-term use in the service specified.
5. Ends:
   a. Provide per the Drawings.
   b. Comply with valve connection requirements in Section 4.3 of ANSI/AWWA C512.
6. Operating Pressure Range: Valve Design Pressure shall be greater than the valve's Maximum and Minimum Working Pressure.
7. Air Valves in water service shall comply with ANSI/AWWA C512 unless otherwise shown or specified.
8. Air/ Vacuum Valves in wastewater service to be long body type, furnished with back flushing attachments.

C. Markings:
1. Mark valves per Section 6.1 of ANSI/AWWA C512.

D. Manufacturers:
1. Apco Valves.
2. Crispin Valves.
3. GA Industries.
4. Val-Matic Valve & Manufacturing Corporation.
5. Henry Pratt.
6. Or equal.

2.2 ACCESSORIES

A. Isolating Valves:
1. Provide isolating valves as shown in the Drawings.

B. Anti-Slam Devices for Water Service:
1. Provide anti-slam devices on inlet to air/vacuum valves where indicated.
2. Pressure rating of anti-slam device shall equal or exceed Valve Design Pressure of connected Air Valve.
3. Ends shall be as required for connecting to Air Valve.
4. Anti-slam devices shall be as normally furnished by specified Air Valve manufacturers and be cast iron or ductile iron with bronze or stainless steel disc and trim.

C. Back-flush Attachments for Wastewater Service:
1. Unless otherwise indicated, provide back-flush attachment for Air Valves.
2. Back-flush attachments shall be as normally furnished by specified Air Valve manufacturer. Provide ports in the Air Valve body for flushing and discharge, each with an isolating valve and quick-connect for attaching hoses.
3. Provide five-foot length of rubber hose with quick-connect for connecting to flushing discharge port.
4. Provide a plugged 2-inch diameter NPT port at bottom of Air Valve body for removal of solids.

D. Vacuum Check Valves:
1. Provide vacuum check valves for Air Release Valves where indicated.
2. Vacuum check valves shall be as normally furnished by Air Valve manufacturer.

E. Throttling Devices
   1. Provide throttling device on discharges of Air/Vacuum Valves where indicated.
   2. Throttling device shall have a field-adjustable Orifice and be as normally furnished by Air Valve manufacturer.

F. Inflow Prevention Devices for Water Service:
   1. Extent: Provide where indicated.
   2. Design: System shall allow connected Air Valve to function normally under normal (non-flooded) conditions.
   3. Size: Venting capacity shall be equal to or greater than connected Air Valve:
   4. Connections: Provide female threaded connections for Air Valve of 1 to 4 inches, and flat faced flanges drilled per ANSI B16.1 Class 125 for larger sizes.
   5. Products and Manufacturers: Provide products of one of the following:
      a. Val-Matic, Series 1300.
      b. Or equal.

2.3 FACTORY PAINTING

A. Interior Surfaces
   1. Extent: Paint ferrous surfaces except stainless steel surfaces.
   2. Paint: Paint shall be as normally provided by Air Valve manufacturer for the specified application, except for potable water service valves which shall be coated with paint complying with ANSI/AWWA C550 and ANSI/NSF-61.

B. Exterior Surfaces
   1. Exterior surfaces of cast-iron, ductile iron, and steel other than stainless steel, except machined surfaces of valves and appurtenances, shall be finish painted.
   2. Surface preparation, painting, and field touch-up painting shall be per manufacturer's paint standards.
   3. Furnish valve with only a prime coat if so indicated.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect Air Valves per Section 5 of ANSI/AWWA C512. Do not ship valves that are not successfully tested.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine conditions under which Work is to be installed and notify ENGINEER in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.

B. Examine valves and remove packing and foreign materials from interior of valve. Report defects to ENGINEER

3.2 INSTALLATION

A. Install valves and appurtenances as shown on the Drawings and per Air Valve manufacturer's recommendations, approved Shop Drawings, and applicable codes and standards.

B. Install valves plumb and vertical.

C. Install with an isolating valve. Remove isolating valve's operating handle or lever and deliver to OWNER.

D. Adjust throttling devices, if provided, for smooth, non-slam and waterhammer-free operation.

END OF SECTION

SECTION 43 21 39

PUMPING STATION – SUBMERSIBLE TYPE WITH VALVE VAULT

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install submersible type pumping station with valve vault, complete and operational.

B. Related Sections:
   1. Section 03 00 05, Concrete.
   2. Section 31 23 05, Excavation and Fill.
   3. Section 32 12 00, Flexible Paving.
   4. Section 32 92 00, Lawns and Meadows.
   5. Section 40 05 05, Exposed Piping Installation.
   6. Section 40 05 08, Wall Pipes, Floor Pipes and Pipe Sleeves.
   7. Section 40 05 19, Ductile Iron Process Pipe.
   8. Section 40 05 53, Process Valves.
   9. Section 43 21 39.13, Submersible Pumps.

1.2 SECTION INCLUDES

A. Submersible type pumping station with valve vault, and including:
   1. Excavating and backfilling.
   2. Wet well with resilient connectors, steel supports, electrical handhole, and vent.
   3. Valve vault with floor door, manhole steps, and vent.
   4. Anchor bolts and anchors.
   5. Submersible pumps with pump guide assemblies, pump access doors, and pump controls.
   6. Piping for pump discharges and drains.
   7. Asphalt pavement.
   8. Electrical.
   9. Painting.
   10. Landscaping.

1.3 SUBMITTALS

A. Provide Manufacturer Standard Submittal Drawings, Operating and Maintenance Instruction Manuals and Parts List to the Engineer. Standard Submittals shall consist of:
   1. Pump Performance Curves.
   2. Pump Outline Drawing.
   3. Station Drawing for Accessories.
   4. Electrical Motor Data.
   5. Control Drawing and Data.
   6. Access Cover Dimensions Minimum.
   7. Typical Installation Guides.

8. Technical Manuals.
9. Operation and Maintenance Manual.
10. Parts List.
11. Printed Warranty.
12. Manufacturer's Equipment Storage Recommendations.
13. Manufacturer's Standard Recommended Start-Up Form.
14. Certified Factory Test Pump Curve.

B. Furnish a manufacturer's affidavit indicating that the pipe, fittings, and valves have been manufactured and tested in accordance with requirements of the applicable referenced Standards, and the Project on which the material is to be used prior to construction.

1.4 DESIGN REQUIREMENTS

A. Design precast structures to meet loading requirements of AASHTO Classification H-20.

B. Minimum Lateral Earth Pressure: 60 pcf.

C. Design for groundwater level no more than 5 feet below grade.

1.5 QUALITY ASSURANCE

A. Precast Concrete Structures:
   1. Qualifications: The precaster shall be PCI-certified; design shall be sealed by a Professional Engineer licensed to practice in the State of South Carolina.
   2. Inspections: ENGINEER reserves the right to inspect the precasting facility prior to and during fabrication, and to collect samples of materials during the fabrication process for testing. Manufacturer shall accommodate facility inspection and sample collection.

B. Piping:
   1. Pipe and fittings to be appropriately marked for identification purposes.
   2. The materials and methods of manufacture, and completed pipes, fittings, and valves are subject to inspection and rejection at all times. OWNER and ENGINEER have the right to make inspections.
   3. Valve manufacturer's name, valve size, pressure rating, and direction of opening to be marked on valve.

PART 2 PRODUCTS

2.1 EXCAVATION AND FILL

A. Fill Materials: Follow Section 31 23 05, Excavation and Fill.

2.2 WET WELL

A. Walls:
   1. Precast reinforced concrete sections; comply with ASTM C478.
   2. Joints: Tongue and groove with rubber gaskets; comply with ASTM C443.

3. Flexible Plastic Gasket Material: Federal Specification SS-S-210A and AASHTO M-198B; Hamilton-Kent Manufacturing Company, Concrete Sealants, Inc., or as approved.

B. Top and Bottom Slabs: Class I concrete; follow Section 03 00 05, Concrete.

C. Concrete Fill: Class II concrete; follow Section 03 00 05, Concrete.

D. Resilient Connector: Comply with ASTM C923.
   1. Manufacturers:
      a. A-Lok Products, Inc., A-Lok Connector.
      b. National Pollution Control Systems, Inc., Kor-N-Seal.
      c. Or as approved.

E. Pipe Brace and Concrete Pipe Support Beam Angle:
   1. Structural steel; ASTM A36.
   2. Type 316 stainless steel expansion anchors.

F. Vent:
   1. Schedule 40 black steel pipe, ASTM A53, Grade B with welded or flanged joints; or ductile iron pipe, AWWA C150 and C151, Class 50 with flange joints. Provide required wall casting. Provide outlet with a bronze wire screen, 0.063-inch diameter wire, 2 mesh size, mechanically held in place between two flanges.

2.3 VALVE VAULT

A. Walls, Top and Bottom Slabs:
   1. Minimum compressive strength 5,000 psi at 28 days; air entrainment of 6 percent, ±1 percent; follow Section 03 00 05, Concrete.
   2. Reinforcing steel meeting ASTM A615 or A616, certified Grade 60.
   3. Welded wire fabric conforming to ASTM A185.
   4. Poured and vibrated and constructed using steel forms.
   5. Wall joints with tongue and groove design; sealed water-tight with gasket and polyurethane sealant.
   6. Wall penetrations for drain piping field-cored.

B. Floor Door and Drain Piping:
   1. Manufacturers:
      a. Babcock-Davis Hatchways, Series B-FGA-H.
      b. The Bilco Company, Type J-AL, H-20.
      c. Halliday Products, Inc., Series H1W.
      d. Or as approved.
   2. Load Rating: AASHTO H-20 wheel loading.
   3. Frame:
      a. Material: Extruded aluminum sections shaped to serve as a continuous drainage gutter with a 1-1/2 inch drain coupling.
      b. Anchors: Continuous anchor flange.
      c. Apply manufacturer's standard protective coating to surfaces of frame that will be in contact with concrete.
   4. Cover:

a. Material: 1/4 inch mill finish aluminum diamond plate, reinforced with stiffening ribs.
b. Hinges: Stainless steel; butt type with compression spring operators enclosed in telescopic tubes.
c. Hold Open Arm: Stainless steel; automatically locks door at 90 degree position; provide vinyl grip handle to release door for closing.
d. Lock: Stainless steel; slam type with fixed handle inside and removable key wrench outside.

5. Hardware and Fasteners: Type 316 stainless steel.
6. Accessories: Provide one key wrench for each door supplied.
7. Drain Piping: Follow paragraph 2.6.C in this Section.

C. Manhole Steps:
1. 1/2 inch diameter steel reinforcing rod continuous through entire length of legs and tread, encapsulated in a copolymer polypropylene plastic.
2. Provide steps with notched tread ridge and retainer lugs on each side of tread ridge.
3. Provide grab bar where indicated.

D. Vent: Schedule 40 black steel pipe, ASTM A53, Grade B, with welded or flange joints; or ductile iron pipe, AWWA C150 and C151, Class 50 with flange joints. Provide required wall casting. Provide outlet with a bronze wire screen, 0.063 inch diameter wire, No. 2 mesh size, mechanically held in place between two flanges.

E. Sump Drain Piping: Follow paragraph 2.6.C in this Section.

2.4 ANCHOR BOLTS AND EXPANSION ANCHORS

A. Anchor Bolts Cast-In-Concrete:
1. Comply with ASTM F593, Type 316 stainless steel.
2. 4 inch minimum hook.

B. Expansion Anchors:
1. Manufacturers:
a. Hilti Corporation, Kwik Bolt II.
b. ITW Ramset/Red Head, Trubolt Wedge Anchor.
c. The Powers Rawl Company, Inc., Power-Stud.
d. Or as approved.
2. Expansion Type: Comply with Federal Specification FF-S-325 Group II, Type 4, Class I.
3. Type 316 stainless steel.
4. Minimum Embedment: 4 inches, unless otherwise indicated.

2.5 SUBMERSIBLE PUMPS

A. Follow Section 43 21 39.13, Submersible Pumps; includes submersible pumps, pump guide assemblies, pump access doors, and pump controls.

2.6 PIPING

A. Piping Schedule:

Application	Material
Submersible pumps discharge to and including connection with force main	Ductile Iron
Valve Vault floor door drain to the sump	PVC
Valve Vault gravity sump drain to wet well	PVC

B. Ductile Iron Pipe and Fittings: Follow Section 40 05 19, Ductile Iron Process Pipe.
   1. Pipe:
      a. Buried: Designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151; minimum Thickness Class 52, with polyethylene encasement; mechanical joint or push-on joint.
      b. Exposed: AWWA C115 flanged joint.
   2. Fittings: AWWA C110.
   3. Exterior Coating: Asphaltic material for buried and within wet well; factory-applied prime coat for all other. Buried fittings may be coated with a fusion-bonded epoxy coating in accordance with AWWA C116.
   4. Interior Lining: Ceramic epoxy lining, Protecto 401 Ceramic Epoxy.
   5. Joints:
      a. Mechanical and Push-On: AWWA C111, rubber gasket, with restrained joints.
         1) Restrained Push-On: Completely boltless; McWane Push-On Restrained Joint Pipe, U.S. Pipe TR Flex, American Flex-Ring, or as approved.
         2) Restrained Mechanical: EBAA Iron, Inc. MEGALUG with Mega-Bond Coating System, or as approved, of ductile iron, and with a working pressure of at least 250 psi, and a minimum safety factor of 2:1.
      b. Flanged: Appendix A of AWWA C115, and ANSI B16.1, Class 125; ductile iron flanges; zinc-plated bolts and nuts.
      c. Bolted Joints: Bolt length shall be such that all threads of the nut will be engaged.
   6. Wall Castings:
      a. Ductile iron; AWWA C110; coated and lined as specified for pipe.
      b. Provide with integral water stop.
      c. End Connections: As indicated on Drawings.
      d. Length: As required for wall thickness.
   7. Polyethylene Encasement: AWWA C105 polyethylene tube; 2 inch wide, plastic-backed adhesive tape, bond to both metal surfaces and polyethylene tube.
   8. Pipe, Fittings, and Appurtenances: Manufactured in United States.

C. PVC Pipe and Fittings:
   1. Pipe: ASTM D1785, Schedule 80.
   2. Joints:
      a. Socket: Solvent-welded.
      b. Threaded: Taper pipe threads.
      c. Flanged: One-piece solid design; compatible with ANSI B16.5, Class 160 metal flanges.
   3. Fittings:
      a. Socket: ASTM D2467.
      b. Threaded: ASTM D2464.
   4. Unions: O-ring seal type; transition type for joining dissimilar materials.

D. Valves:
   1. Plug Valves:
      a. Type: Non-lubricated eccentric plug with resilient plug facings.
      b. Body: Cast iron; ASTM A126, Class B.
      c. Seat: Raised seat with 1/8-inch welded overlay of 90 percent pure nickel. Screw-in seats are not acceptable.
      d. Plug: Cast iron; ASTM A126, Class B; cylindrical seating surface, faced with chloroprene or neoprene, as instructed by manufacturer based on type of service.
      e. Bearings: Stainless steel sleeve type, permanently lubricated. Non-metallic bearings are not acceptable.
      f. Shaft Seals: Multiple V-ring type, externally adjustable and repackable without removing bonnet.
      g. Operator: Valves less than 6 inches, lever actuator. Equip valves 6 inches and larger with gear actuators and handwheel. Enclose gearing in semi-steel housing; provide seals on all shafts; support actuator shaft on permanently lubricated bronze bearings.
      h. Manufacturers: DeZurik, PEC, or as approved.
   2. Swing Check Valves:
      a. Type: Full opening swing type with outside lever and weight, suitable for horizontal or vertical installation. Clapper to swing completely clear of waterway.
      b. Body: Cast Iron; ASTM A126, Class B.
      c. Clapper: For valve sizes as follows:
         1) 4 Inches and Smaller: Bronze.
         2) 6 Inches through 12 Inches: Cast iron with bronze face.
         3) 14 Inches and Larger: Cast iron with rubber face.
      d. Hinge Pin: Stainless steel.
      e. Outside Lever and Weight: Cast iron.
      f. Manufacturers:
         1) M&H Valve Company.
         2) Mueller Company.
         3) Or as approved.
   3. Ball Check Valves, Plastic:
      a. Type: True union design; suitable for horizontal or vertical installation.
      b. Body and Ball: PVC.
      c. Seats and Seals: EPDM or Viton as instructed by manufacturer for intended service.
      d. Manufacturers:
         1) Asahi/America.
         2) Chemtrol.
         3) Or as approved.

E. Pipe Sleeves:
   1. Material: Standard weight steel pipe or 18 gage galvanized steel.
   2. Integral waterstop collar.
   3. Size:
      a. Diameter: Large enough to allow for movement due to expansion and contraction. Allow for continuous insulation wrap.
      b. Length: Flush with wall or floor, unless otherwise indicated.

F. Mechanical Type Seal:

1. Manufacturers: Pipe Seal International, Link-Seal, service designation S; or as approved.
2. Design: Modular mechanical type, consisting of interlocking synthetic rubber links, shaped to fill the annular space between the pipe and sleeve.
3. Size: As instructed by manufacturer based on pipe size and opening size.
4. Sealing Element: EPDM rubber.
5. Pressure Plate: Glass-reinforced nylon plastic.
6. Bolts and Nuts: Type 304 stainless steel.

G. Pipe Couplings for Ductile Iron Pipe:
1. Manufacturers:
   a. Baker Coupling Company, Inc., Series 200.
   b. Dresser Industries, Style 38.
   c. Smith-Blair, Inc., 411.
   d. Or as approved.
2. Type: AWWA C219, bolted-gasketed sleeve type.
3. Components:
   a. Steel middle ring.
   b. Two steel followers.
   c. Two-rubber compound, wedge-shaped gaskets suitable for service intended.
   d. Track-head steel bolts and nuts.
4. Size: As instructed by manufacturer based on pipe diameter.
5. Finish: Factory-applied primer exterior; factory-applied epoxy coating interior.

H. Pipe Supports:
1. Concrete Beams: Follow Section 03 00 05, Concrete.
2. Concrete Piers: Class I concrete; follow Section 03 00 05, Concrete.

2.7 ASPHALT PAVEMENT

A. Comply with Section 32 12 00, Flexible Paving.

2.8 PAINTING

A. Manufacturers:
1. Carboline Company.
2. ICI Paints (Devoe Coatings).
3. The Sherwin-Williams Company.
4. Tnemec Company, Inc.
5. Or as approved.

B. Materials:
1. Coatings: Ready-mixed, except field-catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
2. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality. Use products compatible with painting materials and approved by paint manufacturer.

3. Paint materials and equipment shall be compatible in use.
4. Primer, Intermediate, and Finish coats shall all be from the same coatings manufacturer. Prime coats shall be compatible with and appropriate for use on surface to be coated.

C. Colors:
1. Colors will be selected by OWNER from manufacturer's standard colors.

D. Paint Systems: Paint systems of The Sherwin-Williams Company are listed. Equivalent systems of other manufacturers previously specified are acceptable.
1. Metal - Non-Submerged:
   a. Prime Coat: Recoatable Epoxy Primer B67 Series, B67V5 Hardener, 3-6 mils dft.
   b. First Coat: Hi-Solids Polyurethane B65-300 Series Color, B60V30 Hardener, 3-4 mils dft.
   c. Second Coat: Hi-Solids Polyurethane B65-300 Series Color, B60V30 Hardener, 3-4 mils dft.
2. Metal - Submerged:
   a. Prime Coat: Targuard Coal Tar Epoxy B69B60 / B69V60, 8-12 mils dft.
   b. First Coat: Targuard Coal Tar Epoxy B69B60 / B69V60, 8-12 mils dft.
3. Plastic and Fiberglass:
   a. Prime Coat: DTM Acrylic Gloss Coating B66-100 Series, 2.5-4 mils dft.
   b. First Coat: DTM Acrylic Gloss Coating B66-100 Series, 2.5-4 mils dft.
4. Concrete: Interior surfaces of the wet well shall be coated with a heavy duty, chemical resistant epoxy resin coating, suitable for raw wastewater service in accordance with coating manufacturer recommendations. Use bitumastic 300M by Carboline Company, TNEMEC Vinister Series 120-5001, or approved equal.

2.9 LANDSCAPING

A. Follow Section 32 92 00, Lawns and Meadows.

PART 3 EXECUTION

3.1 EXCAVATION AND FILL

A. Follow Section 31 23 05, Excavation and Fill.

3.2 WET WELL

A. Construct base; follow Section 03 00 05, Concrete.

B. Install wall sections plumb and level. Provide flexible plastic gasket material on the outside shoulder of all wall joints; install so as not to interfere with proper sealing of the rubber gaskets.

C. Place concrete fill in bottom of wet well.

D. Construct top slab; follow Section 03 00 05, Concrete.

E. Install pipe brace and concrete pipe support beam angle.

F. Install electrical handhole. Coat surfaces in contact with concrete with bituminous coating.

G. Install vent plumb and level.

3.3 VALVE VAULT

A. Place precast vault on original earth sub-base with a 6 inch stone leveling course, plumb and level.

B. Place concrete fill in bottom of vault and slope to sump.

C. Vent: Install plumb and level.

D. Floor Door:
   1. Comply with manufacturer's instructions.
   2. Install drain piping; follow paragraph 3.6 in this Section.

E. Install sump drain piping; follow paragraph 3.6 in this Section.

3.4 ANCHORS AND ANCHOR BOLTS

A. Use expansion anchors in precast and cast-in-place concrete.

3.5 SUBMERSIBLE PUMPS

A. Install pumps, guide assemblies, access doors, and controls; follow Section 43 21 39.13, Submersible Pumps.

3.6 PIPING

A. Examination:
   1. Verify location and elevation of wall castings and supports.
   2. Inspect linings for damage.
   3. Verify that polyethylene encasement is in place, where required, before backfilling.

B. Preparation:
   1. Clean gaskets and all surfaces in contact with gaskets; comply with manufacturer's instructions.
   2. Keep interior of pipe and fittings clean.
   3. Prepare piping connections to equipment with flanges.

C. Pipe, Fittings, Valves and Accessories:
   1. Install in accordance with manufacturer's instructions.
   2. Pipe Supports: Follow Sections 03 00 05, Concrete and as indicated on Drawings.
   3. Install wall castings in proper location and elevation before concrete and piping are in place. Boxing out of forms for later placement will not be permitted.
   4. Install bell and spigot pipe with bell end in the direction of laying the pipe.
   5. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

6. Provide access to valves and fittings.
7. Tighten flanged joints with all bolts taking equal stress.
8. Install valves plumb and level, free from distortion and strain from misaligned piping or equipment.
9. Install polyethylene encasement for all buried ductile iron pipe, fittings, and appurtenances. Comply with AWWA C105 Method A and manufacturer's instructions. Completely tape all overlaps and seams. Repair all rips, punctures, and other damage to the polyethylene.

D. Pressure and Leakage Tests: Provide all labor and equipment and clean water to complete the following piping testing:
   1. Submersible Pump Discharge: Follow Section 40 05 05, Exposed Piping Installation.
   2. Drains: Demonstrate free to drain; correct for free drainage.

3.7 ASPHALT PAVEMENT

A. Prepare subgrade per Specification Section 31 23 05, Excavation and Fill.

B. Base Course: 8 inches thick of stabilized aggregate after compaction; two equal courses.

C. Surface Course: 2 inches of Asphaltic Concrete Surface Course (Type 1).

D. Pavement may be installed per alternate design if approved by ENGINEER.

3.8 PAINTING

A. Examination:
   1. Verify that surfaces are ready for application of materials in accordance with the product manufacturer's instructions.
   2. Examine surfaces scheduled to be finished prior to commencement of Work. Report any condition that may potentially affect proper application.
   3. Measure moisture content of surfaces using appropriate method as instructed by the coating manufacturer. Do not apply finishes unless moisture content of surfaces are below the coating manufacturer's acceptable maximums.

B. Preparation:
   1. Mask nameplates, descriptive data on pumps, motors and other equipment.
   2. Correct defects and clean surfaces which affect the Work.
   3. Seal marks which may bleed through surface finishes with sealer instructed by paint manufacturer.
   4. If mildew is encountered, remove by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
   5. Where surfaces are coated with bituminous coating that is not compatible with paint material, remove bituminous coating with abrasive blasting.
   6. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply manufacturer's required primer.
   7. Uncoated Steel and Iron Surfaces:
      a. Welded areas shall be ground smooth per NACE Standard RP 0178.
      b. Use abrasives for blast cleaning that are clean, uniformly graded, and free of oil, soluble salts, chlorides, or foreign matter which could contaminate the blasted

surface. Size the abrasive to produce an anchor pattern profile height as required by the coating manufacturer.

c. Metal surfaces to be painted, and not factory-primed, shall be field-abrasive blasted in accordance with NACE-3 (SSPC-SP6), commercial blast, for non-immersion service; and in accordance with NACE-2 (SSPC-SP10), near-white blast, for immersion service, unless a higher degree of surface preparation is required by the manufacturer.

8. Shop-Primed Steel Surfaces:
   a. Remove loose primer and rust in accordance with SSPC-SP2 Hand Tool Cleaning or SSPC-SP3 Power Tool Cleaning. Feather edges to make touch-up patches inconspicuous. Clean surfaces in accordance with SSPC-SP1 Solvent Cleaning. Prime bare steel surfaces.
   b. Retouch damaged areas of shop-primed items with compatible primer.
   c. CONTRACTOR responsible for compatibility of shop primer with field-finish coats.
   d. Plastic and Fiberglass: Solvent-wipe and scuff sand; apply test sample prior to application to ensure adhesion.

C. Application:
1. Comply with manufacturer's instructions.
2. Do not thin materials, except to comply with manufacturer's instructions.
3. Apply coatings to all surfaces with special attention to hard-to-reach areas such as between the legs of back-to-back angles. Apply each coat to achieve the specified dry film thickness.
4. Do not apply finishes to surfaces that are not dry.
5. Deficiencies in film or coating thickness shall be corrected by the application of an additional coat(s) of material at the expense of CONTRACTOR.
6. Apply each coat to a uniform smooth finish.
7. Special attention shall be given to ensure that edges, corners, crevices and welds receive a film or coating thickness equivalent to that of adjacent surfaces. At no time will wet-on-wet applications be permitted. The finished surfaces shall be free from runs, drips, ridges, waves, laps, brush marks and variations in color, texture and finish.
8. Apply each coat of paint slightly darker than the preceding coat unless otherwise approved.
9. Sand surfaces lightly between coats as required to achieve required finish.
10. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

D. Painting Schedule:
1. Exposed piping, except not within wet well.
2. Structural steel.
3. Vents.
4. Wet well.

3.9 LANDSCAPING

A. Follow Section 32 92 00, Lawns and Meadows.

3.10 FIELD QUALITY CONTROL

A. Operational Test: Demonstrate that all pumping station equipment is electrically, mechanically, structurally, and otherwise acceptable, and that it is safe, in optimum working condition, and conforms to the specified operating conditions by supplying sufficient clear water and operating station through several pumping cycles. During operation 1) observe and record operation of pumps, discharge gage readings, amperage draw, pump controls and liquid level controls, 2) check calibration of instrumentation equipment, test manual control devices, and automatic control systems, and 3) be alert to any undue noise, vibration, or other operational problems.

END OF SECTION

SECTION 43 21 39.13

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
   1. Provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install submersible pump system, complete and operational.

B. Related Sections:
   1. Section 43 21 39, Pumping Station – Submersible Type with Valve Vault.

1.2 SECTION INCLUDES

A. Submersible pumps.

B. Pump guide assemblies.

C. Pump access doors.

D. Pump controls.

E. Standby generator.

1.3 REFERENCES

A. Standards referenced in this section are:
   1. International Standards Organization (ISO), ISO 8528, Reciprocating Internal Combustion Engine Driven Alternating Current Generator Sets.
   2. ISO 9001, Quality Management Systems – Requirements.
   3. NEMA MG-1, Motors and Generators.
   4. NFPA 30, Flammable and Combustible Liquids Code.
   5. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
   6. NFPA 70, National Electrical Code.
   7. NFPA 70E, Electrical Safety in the Workplace.
   8. NFPA 110, Standard for Emergency and Standby Power Systems.
   9. UL 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
   10. UL 508, Safety Standard for Industrial Control Equipment.
   11. UL 2200, Standard for Safety Stationary Engine Generator Assemblies (rated 600 volts or less).

1.4 PERFORMANCE CRITERIA

A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Each pump shall be selected to perform under operating conditions based on, but not limited to:
   1. Capacity (GPM).
   2. Total Dynamic Head (ft).

3. Total Discharge Static Head (ft).

B. Site power furnished to pumping station shall be three phase, 60 hertz, 480 volts, four wire maintained within industry standards. Voltage tolerance shall be plus or minus 10 percent. Control voltage shall not exceed 120 volts nominal.

1.5 SUBMITTALS

A. Product Data
   1. Prior to fabrication, the project's contractor or developer's representative, shall submit three copies of the pumping station manufacturer's data for review and approval.
      a. Submittal shall include shop drawings, electrical ladder logic drawings, and support data as follows: Catalog cut sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, pump characteristic curves showing the design duty point capacity (GPM), head (ft), net positive suction head required (NPSHr), and hydraulic brake power (BHP). Electrical components used in the motor branch and liquid level control shall be fully described.
   2. Prior to fabrication, the project's contractor or developer's representative, shall submit three copies of the on-site generator manufacturer's data for review and approval.
   3. Prior to fabrication, the project's contractor or developer's representative, shall submit three copies of the SCADA system manufacturer's data for review and approval. The submittal data shall include, but not limited to, the RTU Communication's Study.

B. Operations and Maintenance Manuals
   1. Installation shall be in accordance with written instruction provided by the pumping station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
   2. Electrical Documentation shall be specific to the pumping station and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
      a. Functional description of each major component, complete with operating instructions.
      b. Instructions for operating pumps and pump controls in all modes of operation.
      c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
      d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
      e. Schematic diagram of the pump station circuits shall be in accordance with NMTBA and JIC standards. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station

operator, need not to be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.

f. Mechanical layout drawing of the pumping station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.

3. Operation and maintenance instructions, which rely on vendor cut-sheets and literature, which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

1.6 QUALITY ASSURANCE

A. Upon request from the Engineer, the pumping station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment, and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.

B. The pumps shall be heavy duty, electric submersible centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater. The pumps shall be capable of pumping a 3.0" spherical solid.

C. The pumps provided shall be capable of operating in an ambient liquid temperature of 104° F as specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM).

D. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.

E. The pump, mechanical seals and motor unit provided under this specification shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty.

F. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment.

1.7 MANUFACTURER'S WARRANTY

A. The pumping station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below:

1. All equipment, apparatus, and parts furnished shall be warranted for one year, excepting only those items normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O-rings, etc. The pumping station manufacturer shall be solely responsible for warranty of the station and all components.

2. The pump shaft seal shall be warranted for a minimum of four years from date of shipment. Should the seal fail within the first year, the manufacturer shall furnish a new seal, without charge to the Owner, F.O.B factory. The warranty replacement cost for seals after the first year will be pro-rated as follows:

Failure Within	Percent New Price
2 Years	25%
3 Years	50%
4 Years	75%

3. Components failing to perform as specified by the Engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer without cost of parts or labor to the Owner.

B. The warranty provided by the CONTRACTOR to the County shall become effective upon the issuance of a Permit to Operate by the SC DHEC.

1.8 UNITARY RESPONSIBILITY

A. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these specifications that all system components be furnished by a single supplier (unitary source) approved by the County. The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

1.9 DELIVERY, STORAGE AND HANDLING

A. Delivery:
1. Cover all generator air and exhaust openings with vapor inhibiting and water repellent material.
2. Deliver anchorage devices that are to be embedded in cast-in-place concrete in ample time to prevent delaying the Work.
3. Inspect equipment for shipping damage or loose parts upon delivery. Check for evidence of water that may have entered equipment during transit.
4. Notify ENGINEER of loss or damage to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

B. Handle equipment in accordance with manufacturer's instructions. Furnish at least one copy of instructions with equipment at time of shipment.

C. Storage:
1. Store equipment in a clean, dry location with controls for uniform temperature and humidity. Protect equipment with coverings and maintain environmental controls.
2. Store materials for easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect equipment from corrosion and deterioration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide pumps and appurtenances as manufactured by Xylem Flygt Company.

2.2 SUBMERSIBLE PUMPS

A. Unit Base:
   1. The unit base shall comprise of a base plate, perimeter flange, and reinforcements. Base plate shall be fabricated of steel not less than 3-inch thick, and shall incorporate openings for access to all internal cavities to permit complete grouting of unit base after installation. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Base plate and/or flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump unit during shipping and installation.

B. Pump Design:
   1. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There should be no need for personnel to enter the wet-well.
   2. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact.

C. Pump Construction:
   1. Major pump components shall be of gray cast iron, ASTM-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities.
   2. All exposed nuts or bolts shall be AISI type 304 stainless steel construction. All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.
   3. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.
   4. The cable entry shall consist of a single cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable.

D. Impeller:
   1. The impeller shall be semi-open, high efficiency multi-vane design with back swept non-clog design. Impeller material shall be 25% High Chrome Iron (ASTM A-532) (Alloy III A). The leading edge of the semi-open impeller shall be hardened to Rc60 or 650Brinell. It shall be balanced to ISO1940 Grade G6.3.
   2. Enclosed impeller shall be of gray cast iron, Class 35B, dynamically balanced to ISO1940 Grade G6.3, double shrouded non-clogging design having a long through-let

with out acute turns. Enclosed impeller shall be supplied with wear ring system to provide sufficient sealing between the volute and suction inlet.
3. The impeller shall be capable of handling 3-inch spherical solids, fibrous materials, heavy sludge and other matter found in wastewater.
4. Enclosed impellers shall be coated with acrylic dispersion zinc phosphate primer.

E. Motor
1. The pump motor shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber, NEMA B type.
2. The stator windings and stator leads shall be insulated with moisture resistant Class H insulation rated for 180° C (356° F). The stator shall be dipped and baked three times or use trickle impregnation method to achieve Class H insulation and shall be heat-shrink fitted in to the stator housing.
3. The motor shall be designed for continuous duty handling pumped media of 40° C (104° F) and capable of up to 15 evenly spaced starts per hour.
4. The motor and pump shall be designed and assembled by the same manufacturer.
5. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

F. Data Plate: Fabricate data plate from corrosion-resistant metal and mechanically attach to pump. Engrave the plate with the following:
1. Manufacturer's name.
2. Pump size.
3. Serial number.
4. Motor horsepower, speed, and electrical information.
5. Impeller diameter.
6. Capacity and head.

2.3 PUMP GUIDE ASSEMBLIES

A. Pump guide assembly to consist of either guide rails, a self-aligning sliding bracket, upper guide bracket, intermediate guide brackets (as required by manufacturer), lifting chain, and discharge elbow.
1. Guide Rails and Guide Brackets: Type 304 stainless steel; rails designed to mount directly to discharge elbow at the floor and to the upper guide bracket at the top. Provide intermediate guide brackets for rail lengths over 15 feet.
2. Self-Aligning Sliding Bracket: Mounted on pump discharge with a machined mating flange which matches the discharge elbow. Sealing of the discharge connection is accomplished by a simple linear downward motion of the pump, culminating with the entire weight of the pumping unit supported entirely by the discharge elbow.
3. Lifting Rope: Stainless steel cable of sufficient length to extend from the pump in the lowest position in the wet well to the connection at the top of the wet well. Provide a device at the top of the wet well to attach the cable to when not in use. Size cable according to pump weight. Coordinate upper cable end terminating device with requirements for connecting to Owner's lifting equipment.
4. Discharge Elbow: Gray cast iron, ASTM A48, Class 30, designed to mount directly to wet well floor and to anchor and align guide rails with ANSI B16.1, Class 125 flange and a machined mating surface such that the pump to discharge connection is made without the need for nuts or bolts.

2.4 PUMP ACCESS DOORS

A. Load Rating: AASHTO H-20 wheel loading.

B. Frame:
   1. Material: Extruded aluminum sections shaped to serve as a continuous drainage gutter with a 1-1/2-inch drain coupling.
   2. Anchors: Continuous anchor flange.
   3. Apply manufacturer's standard protective coating to surfaces of frame that will be in contact with concrete.

C. Cover:
   1. Material: 1/4-inch mill finish aluminum diamond plate, reinforced with stiffening ribs.
   2. Hinges: Stainless steel; butt type with compression spring operators enclosed in telescopic tubes.
   3. Hold Open Arm: Stainless steel; automatically locks door at 90-degree position; provide vinyl grip handle to release door for closing.
   4. Lock: Stainless steel; slam type with fixed handle inside and removable key wrench outside.
   5. Protective Grating: Aluminum protective grating panel shall be a minimum of 3 inch (76mm) aluminum "I" bar grating with Safety Orange powder-coated finish. Grating shall be hinged with tamper proof stainless steel bolts, and shall be supplied with a positive latch to maintain unit in an upright position. Grating shall have a 6-in. (152mm) viewing area on each lateral unhinged side for visual observation and limited maintenance. A padlock hasp for owner-supplied padlock shall be provided.

D. Hardware and Fasteners: Type 316 stainless steel.

E. Accessories: Provide one key wrench for each door supplied.

2.5 PUMP CONTROLS

A. Control Panel:
   1. Electrical control equipment shall be mounted within a NEMA 4X stainless steel, dead front type, control enclosure. Door shall be hinged and sealed with a neoprene gasket and equipped with captive closing hardware. Control components shall be mounted on a removable steel back panel secured to enclosure with collar studs. All control devices and instruments shall be mounted using threaded fasteners, and shall be clearly labeled to indicate function.
   2. Front panel mounted devices shall be rated NEMA 4X and shall not compromise the NEMA 4X panel rating.
   3. Pump station controls shall conform to third party safety certification. The enclosure and all components mounted on the subpanel or control cover shall conform to UL descriptions and procedures. Control panel assembly panel shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction.
   4. Control panel components to be of highest industrial quality, secured to the back panel with machine screws and lock washers. Mounting holes shall be drilled and tapped; Self- tapping screws shall not be used to mount any component.
   5. A properly sized heavy-duty circuit breaker, with a minimum RMS interrupting rating of 14,000 amperes at 460 volts, shall be furnished for each pump motor. The circuit

breakers must be sealed by the manufacturer after calibration to prevent tampering. An operating mechanism installed on each motor circuit breaker shall penetrate the control panel door. A pad-lockable operator handle shall be secured on the exterior surface. Mechanical interlocks must prevent opening the door until circuit breakers are in the "OFF" position.

6. An open frame, across-the-line, NEMA rated magnetic starter with under-voltage release, and overload protection on all three phases, shall be furnished for each pump motor. Starters of NEMA size 1 and above shall allow addition of at least two auxiliary contacts. Starters rated "0", "00", or fractional sizes are not acceptable. Power contacts to be double-break type made of cadmium oxide silver. Coils to be epoxy molded for protection from moisture and corrosive atmospheres. Contacts and coils to be easily replaceable without removing the starter from its mounted position. Each starter shall have a metal mounting plate for durability. Overload relays to be block-type with melting alloy spindles, having visual trip indication with trip free operation. Pressing the overload-reset lever shall not actuate the control contact until after the overload spindle has reset. Resetting the overload reset lever will cause a snap-action control and not convertible to automatic reset. Trip settings shall be governed by the heater element only, and not by adjustable settings. Heater elements must provide NEMA Class 20 trip times, selected in accordance with actual motor nameplate data. An overload-reset pushbutton, mounted through the control panel door, shall permit resetting the overload relays without opening the control panel door.
7. The control panel shall be equipped with a secondary lightning arrestor to minimize damage to the pump motors and control from transient voltage surges. The arrestor shall utilize silicon-oxide varistors encapsulated in a non-conductive housing. The arrestor shall have a current rating of 60,000 Amps, a Joule rating of 1500.
8. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, low voltage, and voltage unbalance. An integral time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart when power conditions return to normal.
9. Control Circuits
    a. A normal duty thermal-magnetic circuit breaker shall protect all control circuits by interrupting control power.
    b. Pump mode selector switches shall permit manual start or stop of each pump set individually, or permit automatic operation under control of the liquid level control system. Manual operation shall override all shutdown systems, except the motor overload relays. Selector switches to be heavy duty, oil-tight design with contacts rated NEMA A300 minimum.
    c. Pump alternator relay to be electro-mechanical industrial design. Relay contacts to be rated 10 amperes minimum at 120 volts non-inductive. A switch shall permit the station operator to select automatic alteration of pumps, to select pump set number one to be "lead" for each pumping cycle, or to select pump set number two to be "lead" pump for each pumping cycle.
    d. Six-digit elapsed time meter (non-reset type) shall be provided for each pump set to indicate total running time of each pump set in "hours" and "tenths of hours." A pilot light shall be wired in parallel to indicate that the motor is energized and should be running.
    e. A high pump temperature protection circuit shall override the level control and shutdown the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected

to a high pump temperature shutdown circuit. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the pump shutdown circuit to interrupt power to the motor. A visible indicator located on the control panel door shall indicate motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of the circuit is not acceptable.

f. A duplex ground fault receptacle providing 115 VAC, 60 Hz, single phase current, will be mounted on the side of the control enclosure. Receptacle circuit shall be protected by a 15-ampere thermal-magnetic circuit breaker.

2.6 AUXILIARY POWER TRANSFORMER CONTROLS AND ACCESSORIES

A. The lift station shall be equipped with a 3 KVA step-down transformer to supply 115-volt, AC, Single phase for the control and auxiliary equipment. The primary and secondary side of the transformer are to be protected by a thermal magnetic circuit breaker sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door, and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in “OFF” position.

B. All wiring, workmanship, and schematic wiring diagrams shall comply with Applicable standards and specifications of the National Electric Code (NEC). All user serviceable wiring shall be type MTW or THW, 600 volts, color coded as follows:

1.	Line and Load Circuits, AC or DC power	Black
2.	AC Control Circuit Less Than Line Voltage	Red
3.	DC Control Circuit	Blue
4.	Interlock Control Circuit from external source	Yellow
5.	Equipment Grounding Conductor	Green
6.	Current Carrying Ground	White
7.	How With Circuit Breaker Open	Orange

C. Control circuit wiring inside the panel, with exception of internal wiring of individual components, shall be 16-gauge minimum, type MTW or THW, 600 volts. Power wiring to be 14-gauge minimum. Motor branch wiring shall be 10-gauge minimum. Motor branch and other power conductors shall not be loaded above 60 degrees Celsius temperature rating, on circuits of 100 amperes or less, nor above 75 degrees Celsius on circuits over 100 amperes. Wires must be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel shall be ring tongue type with nylon-insulated shanks. All wires on the back panel shall be bundled and tied. All wires extending from components mounted on door shall terminate at a terminal block mounted on the back panel.

D. All wiring outside the panel shall be routed through conduit. Control wires connected to door mounted components must be tied and bundled in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall allow the door to swing full open without undue stress or abrasion. Bundles shall be held on each side of hinge by mechanical fastening devices. Factory installed conduit shall conform to following requirements:

1. All conduit and fittings to be UL listed.

2. Use PVC-coated rigid steel for exterior conduit runs in hazardous, wet, and corrosive locations.
3. Use PVC-coated rigid steel conduit for individual conduits direct buried in the ground.
4. Liquid tight flexible metal conduit to be constructed of smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight polyvinyl chloride cover.
5. Conduit to be supported in accordance with articles 344 and 350 of the National Electric Code.
6. Conduit shall be sized according to the National Electric Code.

E. Station manufacturer shall ground all electrical equipment inside the pump station to the panel powering the equipment. The CONTRACTOR shall provide a minimum of one earth driven ground rod connection at the service entrance equipment in accordance with the National Electric Code (NEC) and local requirements.

F. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
1. Equipment serial number
2. Supply voltage, phase and frequency
3. Current rating of the minimum main conductor
4. Electrical wiring diagram number
5. Motor horsepower and full load current
6. Motor overload heater element
7. Motor circuit breaker trip current rating
8. Name and location of equipment manufacturer

G. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified. Switches indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

H. Liquid Level Monitoring and Control
1. The level monitoring and control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
2. The level monitoring and control system shall be capable of operating as a conductivity probe-type system for liquid level control and with a float-ball system for high and low level alarms, as manufactured by ITT Flygt, DEVAR Inc., or manufacturer approved equal by York County.
3. The level control system shall utilize the alternator relay to select first one pump set, then the second pump set, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle.
4. The level control system shall be provided with pump start and stop delays to prevent simultaneous motor starts and to reduce the potential of hydraulic surges during motor shutdown. Motor starts shall also be sequenced to provide step loads on the generator.
5. The level control system shall utilize the conductivity probe-type system which shall continuously, monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the conductivity probe-type system shall start the motor for one pump set when the liquid level in the wet well rises to the “lead pump start level”. When the liquid is lowered to the “lead pump stop level”, the conductivity probe-type system shall stop these pumps. These actions shall

constitute one pumping cycle. Should the wet well level continue to rise, the conductivity probe-type system shall start the second pump set when the liquid reaches the “lag pump start level” so that all pumps are operating. These levels shall be adjustable as described below.

6. The conductivity probe-type system shall include integral components to perform all pressure sensing, signal conditioning. EMI and RFI suppression. DC power supply and 120 volt outputs. Components shall be solid state and shall be integrated with other components to perform as described below.
7. The conductivity probe-type system shall be capable of operating on a supply voltage of 108 volts to 132 volts AC, 60 hertz, in an ambient temperature range of –10 degrees Celsius (14 degrees Fahrenheit) through +55 degrees Celsius (131 degrees Fahrenheit). Control range shall be 0 to -----.0 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be retained using a non-volatile lithium battery backup.
8. The conductivity probe-type system shall consist of the following integral components: display, output relays:
    a. The conductivity probe-type system shall incorporate a digital back-lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet-well, and the preset start and stop level for both lead and lag pump. The display shall include 20, 0.19 inch high alphanumeric characters calibrated to read out directly in feet of water, accurate to within one-tenth foot (0.1 foot), with a full-scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
    b. Level adjustments shall be electronic comparator set points to control the levels at which the lead and lag pumps start and stop. Each of the level settings shall be adjustable and accessible to the operator without opening the cover panel. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation.
    c. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be oil tight design with contacts rated NEMA A300 minimum.
    d. Station manufacturer will supply one 115-volt AC alarm light fixture with vapor-tight red glove, guard, conduit box, and mounting base. The design must prevent rain water from collecting in the gasketed area of the fixture, between the base and globe. The alarm light will be shipped loose for installation by the CONTRACTOR.
    e. Station manufacturer will supply one 115-volt AC weatherproof alarm horn with projector, conduit box, and mounting base. The design must prevent rainwater from collecting in any part of the horn. The alarm horn will be shipped loose for installation by the CONTRACTOR.

2.7 TELEMETRY

A. Each pump station shall be supplied with a Supervisory Control and Data Acquisition (SCADA) Remote Terminal Unit (RTU). The work to be accomplished under this specification shall consist of furnishing the equipment necessary for modifying the existing automatic control and monitoring system. The equipment shall be designed, fabricated, programmed, tested, started-up, and warranted by a single supplier.

2.8 ON-SITE GENERATOR SYSTEM

A. General:
   1. All pump stations shall have an automatic standby power generation system conforming to these specifications.
   2. The system shall consist of a diesel-fueled standby generator in a weatherproof enclosure complete with all equipment and accessories required to automatically supply power to the pump station during a utility power failure.

> As an alternate to a diesel-fueled standby generator, the County may request the use of a natural gas fueled standby generator. The natural gas fueled standby generator shall meet all the following requirements as appropriate for a natural gas fueled engine.

B. Engine:

1. Engine block material	Cast Iron
2. Cylinder head material	Cast Iron
3. Crankshaft material	Hardened Steel
4. Pistons	Aluminum Alloy
5. Valve seats	Replaceable
6. Maximum Rated RPM	1800

C. Engine Governor:

1. Type	Mechanical
2. No-load to full load frequency regulation	5.0%
3. Steady state regulation	+/-0.33%
4. Overspeed shutdown	Automatic solid state

D. Engine Lubrication System:

1. Oil pump	Gear type
2. Oil filter	Full flow, cartridge
3. Low oil pressure shutdown	Automatic

E. Engine Cooling System:

1. Type of system	Pressurized, closed recovery
2. High temperature shutdown	Automatic
3. Low coolant level shutdown	Automatic
4. Fan	Pusher type with guard
5. Engine block heater	1,000 watts (min), 120 VAC, thermostatically controlled
6. Coolant	Water/ethylene glycol (-34° protection)

F. Engine Fuel System:

1. Fuel	#2 Diesel
2. Fuel filter	5 micron
3. Injection type	Direct
4. Fuel pump	Mechanical, engine driven
5. Fuel tank	integral, UL listed, double-walled, steel fuel storage
6. Fuel tank capacity	24 (min.) hours @ rated load

7. Fuel tank accessories — Fuel level indicator
8. Low fuel indicator switch (on at 20% capacity), Screened vent for double wall cavity, Drain port

G. Engine Exhaust System:
1. Silencer — Critical
2. Mounting — External with weather cap
3. Connection — Flexible stainless steel pipe

H. Engine Combustion Air Intake:
1. Air cleaner — Replaceable dry cartridge

I. Engine Electrical:
1. Starter motor — 12 or 24 volt
2. Battery charge alternator — 30 amps (min)
3. Crank limiter — Solid state
4. Battery — 2 - 12 volt (series or parallel, as appropriate)
5. Battery mounting — Rack inside enclosure
6. Polarity — Negative ground
7. Standby charger — 10 amp, automatic float

J. Generator:
1. The generator shall meet the following requirements:
   a. Generator Specifications**:**
      1) Generator type — 4 pole, revolving field
      2) Output — 12 lead, reconnectable
      3) Stator — "Skewed" design
      4) Housing — Drip proof design, self-ventilated
      5) Rotor insulation — Class F
      6) Stator insulation — Class F
      7) Bearings — Sealed, pre-lubed
      8) Engine coupling — Direct, flexible disc
      9) Protection — Output circuit breaker (manual reset)
   b. Excitation:
      1) Exciter type — Brushless
      2) Protection — Manual circuit breaker
   c. Regulation:
      1) Type — Solid state
      2) Regulation — +/-2% steady state
      3) Voltage adjustment — 5% - manual rheostat

K. Generator Set Controls
1. The engine-generator set shall be equipped with a control panel having the following features:
   a. Engine Controls & Indicators:
      1) Engine Gauges: — Oil pressure
         Coolant temperature
         Battery charging ammeter
      2) Annunciator: — Low oil pressure shutdown
         High temperature/low coolant

	level shutdown
	Overcrank shutdown
	Overspeed shutdown
	Low fuel
3) Engine hour meter	99,999.0 hour
4) Remote engine hour meter located at transfer switch	99,999.0 hour
5) Engine control switch	Off/Manual/Automatic

L. Generator Controls & Indicators:

1. Gauges	AC frequency
	Output voltage
	Output current
2. Gauge Selector switch	3 position with "off"
3. Manual voltage adjustment	Rheostat, 5% adj. range

M. Alarm Output Contacts
1. Generator Fail
2. Generator Operating
3. Low Fuel
4. Alarm output contacts are to be wired to the local monitoring RTU.

N. Generator Set Enclosure & Mounting
1. The engine-generator set shall be enclosed in a weatherproof housing which meets the following specifications:

a. Access panels	Lockable (keyed alike), hinged and removable
b. Hardware	Stainless steel
c. Finish	Baked enamel over zinc coated steel
d. Mounting	Welded steel base with vibration isolators
e. Mounting location	Top of fuel tank

O. Automatic Transfer Switch:
1. The automatic transfer switch to be supplied as part of the standby power system shall meet all applicable requirements set forth by the National Electrical Code and OSHA. The transfer switch shall also conform to the requirements as specified below:

a. Enclosure:	
1) Mounting type	Surface
2) Enclosure type	NEMA 3R, lockable
b. Electrical Ratings:	
1) Operating voltage	Compatible with station voltage
2) Operating current	No less than main disconnect
3) Withstand and closing rating	10,000 Amps, RMS, Symm. (min.)
4) Normal input connection	Service entrance rated
c. Transfer Switch:	
1) Operating mechanism	Single solenoid
2) Holding mechanism	Mechanical
3) Interlock	Mechanical and electrical
4) Contact material	Silver alloy
5) Neutral delay	0.1 – 10 sec.

d. Timer Setting Ranges:

1)	Utility dropout	70-95%
2)	Utility pick-up	70-95%
3)	Utility interrupt delay	0.1 – 10 sec.
4)	Engine min. run	5 – 30 min.
5)	Engine warm-up	5 – 180 sec.
6)	Return to utility delay	1 – 30 min.
7)	Engine cool-down	1 – 30 min.
8)	Standby voltage	70 – 90%
9)	Standby frequency	80 – 90%
10)	Exerciser	Once/week

e. Operation Selectors:

1)	Exercise	With/Without load
2)	Engine warm-up bypass	On/Off
3)	Neutral delay	On/Off
4)	Mode selector	Manual Test/Standby/Off

P. Standby Power System Capacity:

1. The standby power system shall be capable of providing continuous standby power for the wastewater pumping station. The generator set shall be capable of starting the two pump motor loads sequentially with the full miscellaneous load applied, with no more than 30% dip. **The *minimum* acceptable generator set rating shall be 25 KW for any station.** The CONTRACTOR shall coordinate the starting requirements of the exact pumps being furnished on the project with the generator set supplier to ensure the generator set has adequate motor starting capability.

Q. Installation:

1. The generator set shall be mounted and anchored to a reinforced concrete pad, located to provide adequate access for fueling and servicing. The exact dimensions of the pad, conduit entries and anchor bolts shall be based on the manufacturer's shop drawings. The pad shall have outer dimensions 1 foot greater than the footprint of the base tank, to provide 6 inch of exposure on all sides. The minimum thickness of the pad shall be 12 inch, with a single mat of #6 rebar, 12 inch OCEW and located in the lower third of the concrete thickness. The weight of the mounting pad shall be equal to or greater than the weight of the generator set. All exposed edges shall be chamfered or rounded with an edging tool.

R. Field Tests:

1. The CONTRACTOR shall provide start-up and testing services utilizing personnel specifically authorized to perform such services by the standby power system manufacturer. The start-up services shall be scheduled with the COUNTY with no less than three days notice. The start-up and testing service shall include a complete inspection of the installation, initial break-in of the engine, testing the system performance, and servicing the engine. The following tests shall be performed in the presence of the COUNTY or its representative:
   a. Generator output voltage unloaded and loaded, each phase, based on 2-hour load bank test.
   b. Voltage dip as loads are applied.
   c. Complete operating sequence (simulated utility power failure and restoration).
   d. Pressure test engine cooling system for leaks.

e. Test battery charging systems.
f. Test operation of all safety systems.
g. Upon completion of break-in and testing, the engine shall be serviced as follows:
1) Change engine oil and filter.
2) Verify anti-freeze protection (-34° F).
3) Refill fuel tank (tank shall be left full).
4) Check belt tension.
5) Check battery connections and state of charge.

2. During this start-up period, the COUNTY'S maintenance personnel shall be fully instructed in the proper maintenance of the standby power system.
3. All equipment and supplies for testing and service shall be provided by the CONTRACTOR.

S. Manufacturer:
1. The generator set, controls, and transfer switch shall be furnished by a single supplier. The generator set and accessory equipment shall be supplied by Caterpillar/Olympian, Onan/Cummings, Kohler, or approved equal.
2. The supplier shall be the authorized dealer of the engine-generator set manufacturer, and shall be fully qualified and authorized to provide service and parts for the engine and generator at any time during the day or night. Parts and service shall be available 24 hours per day 7 days a week, from a location within a 100-mile radius of the location of the installed generator set.

T. Shop Drawings:
1. Prior to purchase of stand-by power generation equipment, the CONTRACTOR shall submit not less than four (5) sets of data to the County Representative for approval, including equipment data, accessories, sizing calculations, etc., as may be appropriate to determine compliance with these Specifications.

U. Operating Instructions:
1. Six (6) complete copies of operating instructions and parts list shall be provided prior to acceptance of the unit. Parts list shall include schedule of type and quantity of parts recommended for stock.

V. Spare Parts:
1. The following spare parts shall be furnished:
a. Engine Fan & Accessory Drive Belts 1 sets
b. Oil, Fuel & Air Filters 2 sets
c. Spare Indicator Lamps & Fuses of each type used 2 sets
2. Spare parts shall be boxed and labeled with the pumping station identification.

W. Warranty:
1. The complete standby power generating system shall be warranted for one year after the acceptance of the sewer pump station by the COUNTY. The warranty shall cover all defects in equipment, parts, assembly and installation. The warranty shall be issued in writing by the supplier and delivered to the COUNTY Representative.

2.9 FACTORY INSPECTION

A. Perform motor and cable insulation test for moisture content and insulation defects.

B. Run pump dry to check for proper rotation and mechanical integrity.

C. Run pump submerged for 30 minutes in water.

D. Remove pump from water; perform motor and cable insulation test.

E. A written report on the above shall be prepared by the test engineer, certified and submitted to ENGINEER.

2.10 FACTORY PERFORMANCE TEST

A. Test each pump at the factory; submit certified performance curves to ENGINEER prior to shipment.

B. Test each pump at no less than three head conditions including shut-off head and design head.

C. Provide a standard NPSH curve based on testing of standard test pump.

2.11 SPARE PARTS

A. One spare fuse for each fuse in pump control panel.

B. One spare pilot light for each pilot light in pump control panel.

C. One spare float switch with length of integral cord sufficient to replace longest provided.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's instructions.

B. Float Switches:
   1. Install float switches at elevations indicated.
   2. Install stainless steel cable and anchor assembly so that anchor freely hangs within 6 inches of well bottom, and so that float switches will be easily accessible for cleaning and replacement.
   3. Attach float switch cord to cable with nylon wire ties spaced 12 inches apart and starting 6 to 8 inches above top of switch.
   4. Terminate float wiring using normally open or normally closed configuration as required for proper operation. Cap the unused third wire in the junction box.

3.2 MANUFACTURER'S START-UP SERVICES

A. Provide a minimum of one 8-hour day of service.

END OF SECTION